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APRIL 18, 1955

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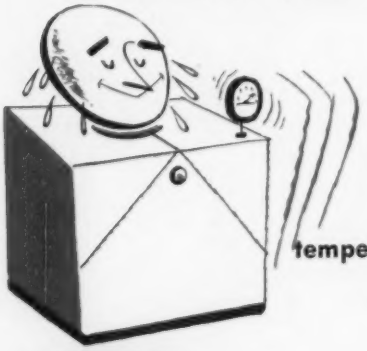

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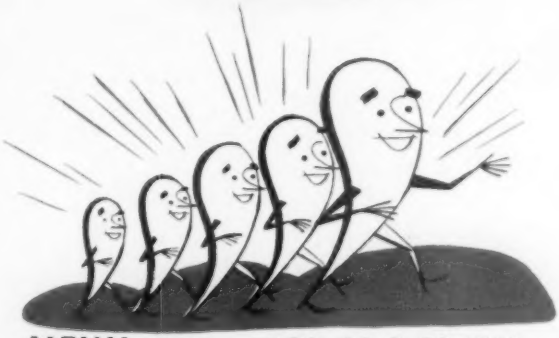

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RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER

New De-Icers improve airflow on TWA "Super-G" Connies

THE wings on TWA's new, luxurious Lockheed "Super G" Constellations have the most efficient ice protection yet developed—new B. F. Goodrich *chordwise* De-Icers.

Top photograph shows the basic design change. Notice how the small rubber tubes that inflate to snap off ice are built chordwise, in line with the air stream.

This enables the new B. F. Goodrich De-Icers to maintain a smooth flow of air during the brief inflation period.

Like the famous B. F. Goodrich Type 21 De-Icers, *chordwise* De-Icers remove ice quickly, effectively. Both designs operate with almost three times the air pressure of ordinary wide tube De-Icers. The high pressure inflates the tubes with a snap. Ice breaks off fast and clean.

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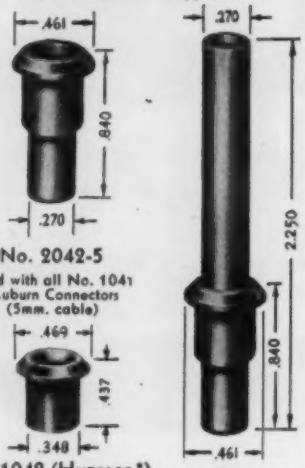
Ozone Resistant Hypreen*



No. 2042-5
Used with all No. 1041 Auburn Connectors (5mm. cable)

No. 1042 (Hypreen*)
No. 1043 (Silicone)
Used with all No. 1041 Auburn Connectors (7mm. cable)

No. 1042-5
Used with all No. 1041 Auburn Connectors (5mm. cable)

*Auburn Synthetic Rubber

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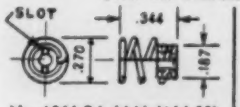
(Used with 3-48 Stud)



No. 1066-9A (AN 4164-22) with stainless steel coil springs

No. 1066-9V with Inconel volute springs

Teflon Connectors

with Inconel volute springs

1041-TV (9/16")
1099-TV (1")

Connectors with stainless steel coil springs

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1041-M Mycalex
1041-D Alumina
(AN 4164-2)

1041

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1099-M Mycalex
1099-F Phenolic
1099-D Alumina
(AN 4164-1)

1099

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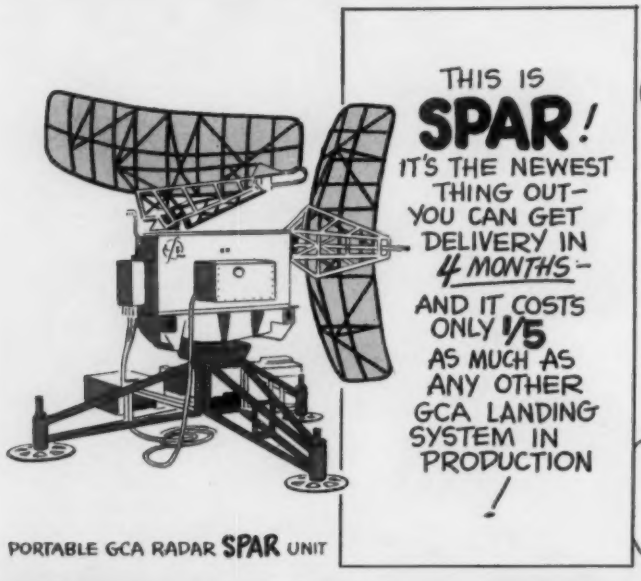
DAVE - YOU CAN'T AFFORD NOT TO HAVE IT - LOOK...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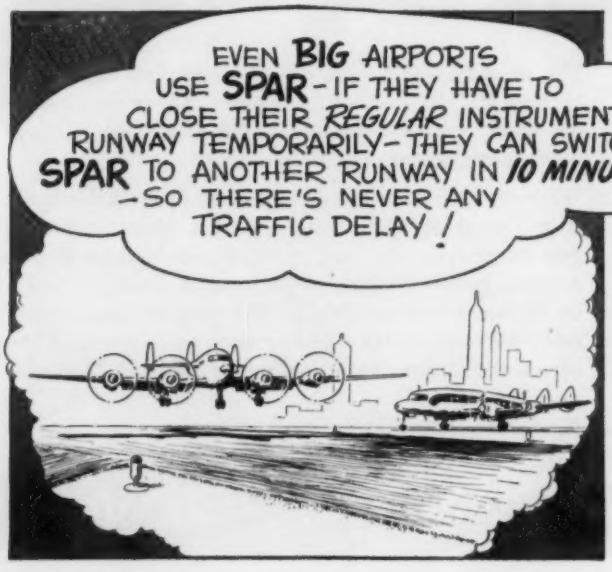
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NEWS DIGEST

Domestic

Flight tests on the North American F-100 in a supersonic speed range not previously measured will be made by personnel of the Cornell Aeronautical Laboratory, Inc., later this spring. Aim of the 100-hour program: complete flight determination of longitudinal and lateral stability derivatives at Mach numbers where these data are not in existence.

13F helicopter, Bell Aircraft Corp.'s test vehicle for evaluating turbine-powered rotary-wing aircraft, was accepted by the Air Force and started through final trials at the builder's Fort Worth plant. Equipped with a Turbomeca Artouste gas turbine engine, the light copter is a joint USAF-Army development project

Pan American World Airways will start daily flights June 1 from Chicago and Detroit to Europe, the first daily international air service out of the two cities. PAA now operates three flights a week from the Midwest gateways, will step this up to five Apr. 24 and to seven June 1.

Long-range radar air traffic control started operating in the New York metropolitan area last week (AW Feb. 14, p. 107). For the first six weeks, Civil Aeronautics Administration and USAF will train controllers to use the new tool for channeling the flow of aircraft to the area's six airports. By May 1, radar will begin to replace the present method of posting and handling flights.

Continental Air Lines will send top-executive group, headed by president Robert F. Six, to England and Europe next month to confer with transport and engine builders on CAL's future needs. To be visited during the three-week tour: Britain's Vickers-Armstrongs and Rolls-Royce and Fokker Royal Netherlands Aircraft Factories in Holland.

Longest operational runway in the U.S., completed at Albuquerque's Municipal Airport, is shared jointly by commercial airlines and Kirtland AFB. The 13,773-ft. runway, rebuilt at a cost of $2.5 million, is exceeded in length only by the 15,000-ft. testing strip at Edwards AFB.

Heavy forging press plant at Cleveland, USAF's first completed facility, will begin production May 5. Operated by Aluminum Company of America, the $40-million installation houses 50,000 and 35,000-ton forging presses.

C-130A Takes Off Quickly on First Flight

USAF's first production C-130A lifts off the runway after a takeoff run of 855 ft. at Dobbins AFB, Ga., near Lockheed Aircraft Corp.'s Marietta plant. The 54-ton turboprop-powered freighter was airborne on this first flight eight seconds after the brakes were released and had climbed to 2,500 ft. by the time it passed over the end of Dobbins' 10,000-ft. runway. The C-130A is powered by four Allison T56s.

Fifteen P2V-7s assigned to NAS Jacksonville, Fla., are the first of Lockheed Aircraft Corp.'s latest version of the Neptune anti-submarine patrol bomber to go on squadron service. Delivery followed preliminary evaluation tests at Patuxent River, Md.

J65 turbojet deliveries by Curtiss-Wright Corp. now total more than 5,000.

Boeing Airplane Co. offered a 2.75% wage increase to its nearly 6,000 engineering employes in Seattle and Wichita. The raise would be retroactive to Oct. 1 and include higher overtime pay plus a retirement plan.

New data-processing systems will be developed by Minneapolis-Honeywell Regulator Co. and Raytheon Manufacturing Co. To engineer and market the high-speed electronics projects, the two companies have formed Datamatic Corp. at Waltham, Mass. Honeywell will own 60% of the new firm, Raytheon 40%.

Convair Division of General Dynamics Corp. sold six Model 340 transports to Saudi Arabian Airlines, will start deliveries May 20 and complete them June 17. Total value of the order, including spares: $6 million. The planes will be taken from the production line of 33 C-131Ds ordered by the Air Force, postponing final delivery of USAF's contract until next year.

Los Angeles Airways formed a passenger traffic department to handle the helicopter airline's expanded activities.

Lockheed Aircraft Corp. delivered its 4,000th jet trainer to the armed forces. The company says 20.5-million man-hours and $118 million in material went into the building the 4,000 T-33s, RT-33s and TV-2s.

Military Air Transport Service won the Daedalian Trophy for the lowest aircraft accident rate in the Air Force. Overall record for MATS: seven accidents per 100,000 flying hours.

Temco Aircraft Corp. signed a new contract with Lockheed Aircraft Corp. that will extend production of P2V outer wing panels at the Dallas plant through 1956.

International

Civil Air Transport transferred substantially all its assets, business and contracts to Asiatic Aeronautical Co., a subsidiary formed by the airline under Nationalist China's company law. Despite the paper transaction, the company will continue to operate as CAT.

CF-100 production stretchout may force A. V. Roe Canada to cut assembly line forces at its subsidiary companies, Avro Aircraft, Ltd., and Orenda Engines, Ltd. Probable layoff: 1,000 workers from each firm.

Okanagan Helicopters, Ltd., purchased Canadian Helicopters, Ltd., and its subsidiary, Smart Aviation, Ltd. This gives Okanagan bases on Canada's east and west coasts and increases its fleet to eight Sikorsky S-55s and 22 Bell copters.

The 200th Freighter built by Bristol Aeroplane Co. was delivered to Britain's Air Charter, Ltd. Of the 200 all-cargo transports sold so far, 90% were purchased by operators in 18 countries overseas.

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R-320 2-way	1	1800	1500	2¼ lb
R-330 3-way	1	1800	1500	2¼ lb

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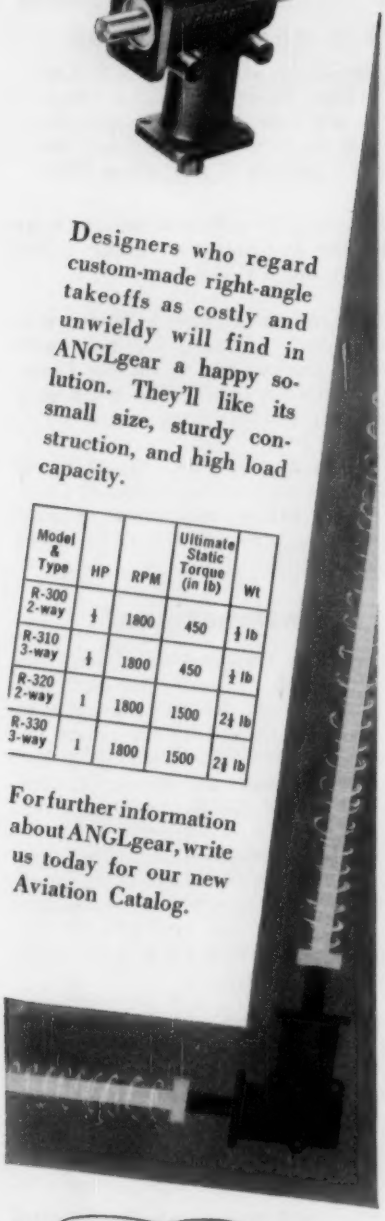

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WHO'S WHERE

(These personnel changes in the aviation industry were announced:)

In the Front Office

Robert S. Kinsey, vice president-operations Reaction Motors, Inc., Rockaway, N. J.

William M. Pease, vice president and general manager, Feedback Controls, Inc., Alexandria, Va.

Robert E. Wieland, vice president and assistant to the president of National Airlines; **Gilbert Paul,** assistant vice president-New York; **William A. Perry,** assistant vice president-sales; **Lewis W. Dymond,** assistant vice president-operations; **Howard A. Pike,** assistant vice president-maintenance and engineering, and **Richard A. Fitzgerald,** assistant vice president-Washington.

Lester J. Henderson, vice president in charge of Weatherhead Co.'s new Aviation Division, Antwerp, Ohio.

Charles H. Calhoun, vice president-engineering and maintenance, Continental Air Lines.

W. E. Bartling, vice president and assistant to the president, Flying Tiger Line; **George M. Messenger,** vice president-maintenance; **Frank Lynott,** director of freight operations; **John L. Higgins,** sales director; **J. P. Goldsmith,** director of contract operations; **Edward Pinke,** superintendent of flight operations. New department directors: **Al Penrose,** maintenance training; **Jack Lippert,** production control; **K. A. Marietta,** surplus sales; **Douglas Smith,** general traffic; **Ed Hembree,** airfreight stations, and **Jack Martin,** crew control.

Changes

Dr. William Ballhaus, chief engineer of Northrop Aircraft, Inc., Hawthorne, Calif., took charge of the SM-62 Snark project. Other changes: **Ray Gayner,** assistant to the vice president-manufacturing; **George Douglas,** assistant chief engineer, and **T. V. Jones,** head of new directorate of development planning.

Fred E. Harrell, general manager of Marquette Metal Products Co., Cleveland, division of Curtiss-Wright Corp.

Gerhard Neumann, general manager of the jet engine department of General Electric Co.'s Aircraft Gas Turbine Division, Cincinnati; **George E. Fouch,** general manager of the Evendale operating department.

Maj. Gen. Gordon P. Saville (USAF Ret.), director of Ramo-Wooldridge Corp.'s new office of military requirements, Los Angeles.

Edgar F. Mason, general sales manager of Kaynar Co., Los Angeles, Calif.

Honors and Elections

Warren J. North, research scientist and pilot at the Lewis Flight Propulsion Laboratory of National Committee for Aeronautics, and **William B. Browne,** senior at North Carolina State College, won Institute of the Aeronautical Sciences' flight test fellowships for two years of graduate study at Princeton University.

INDUSTRY OBSERVER

► Royal Canadian Air Force hasn't yet settled on a successor to the F-86 being built by Canadair Ltd. for its future fighter requirements. Leading contenders now are the Convair F-102 all-weather interceptor and the Lockheed F-104 day superiority fighter.

► **USAF is interested in a long range guided missile to be used for photo-reconnaissance work.**

► Watch for Bell Aircraft Corp. to branch out into other types of helicopter operations in addition to its subsidiary for uranium exploration (AW Apr. 4, p. 26). Bell feels that use of its own helicopter operating subsidiaries is the best way to stimulate growth of the commercial helicopter market and provide cost data for prospective new helicopter operators.

► **Royal Canadian Air Force is interested in an Americanized transport version of the Bristol Britannia powered by Bristol's B. E. 25 supercharged turboprop engine. RCAF has an acute aerial logistics problem for support of its fighter forces with NATO in Europe and its air defense squadrons spread across the northern perimeter of the American continent. Canadair Ltd., now tooling for production of the CL-28 maritime reconnaissance version of the Britannia would also build the transport version.**

► North American Aviation will supply F-86F Sabres for the newly authorized German air force from its recent USAF order for 500 Sabres that resulted in putting this model back into production. Some of these Sabres also probably will go to Latin American air forces.

► **Aircraft industry is buzzing with rumors of an impending purchase of Marquardt Aircraft by United Aircraft Corp. Purpose would be to get UAC's Pratt & Whitney Division into ramjet production now that Marquardt-developed supersonic ramjets appear destined for large scale use in USAF anti-aircraft and bombardment missiles.**

► First XF2Y Sea Dart built by Convair was only plane of this series to be fitted with single V-shaped hydroski for taxi tests. It isn't likely that this single ski arrangement will be adapted for this jet fighter seaplane.

► **Augmented General Electric J73 is under consideration for adaption to North American F-86H. Augmentation scheme involves burning within an engine tailpipe fitted with variable area nozzle developed by Marquardt Aircraft Co.**

► Vertical testing of Lockheed Aircraft Corp.'s XFV-1 VTOL aircraft has been held up to check surging on engines and propellers. Other changes are also being made. Aircraft has been tested in the vertical flight position with its modified engine but has never made a vertical takeoff or vertical landing.

► **Bell Aircraft's VTOL jet-propelled vertical-rising airplane can fly backwards and sideways. In tests at Niagara Falls, it has flown backward at speeds ranging from 5 to 15 mph.**

► Tactical Air Command now has its first squadron of 14 Piasecki H-21Bs at Sewart AFB, Tenn.

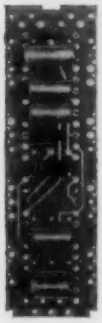
► **Chance Vought Aircraft is working on a new high-performance guided missile for the Navy.**

► The French S.E. 210 Caravelle jet transport prototype is completed and the aircraft is being equipped with extensive instrumentation required for the flight test program. Fuselage of the second prototype is being covered.

► **Some changes in the Douglas RB-66, twin-jet Air Force bomber, include: new canopy and cockpit layout, change from the J-71-9 to the J-71-11 engine and a new fuel system.**

► Lockheed is building the TF-104, a two-seater, trainer version of its supersonic fighter. Both seats will eject downward.

WORLD'S MOST REVOLUTIONARY ASSEMBLY LINE?



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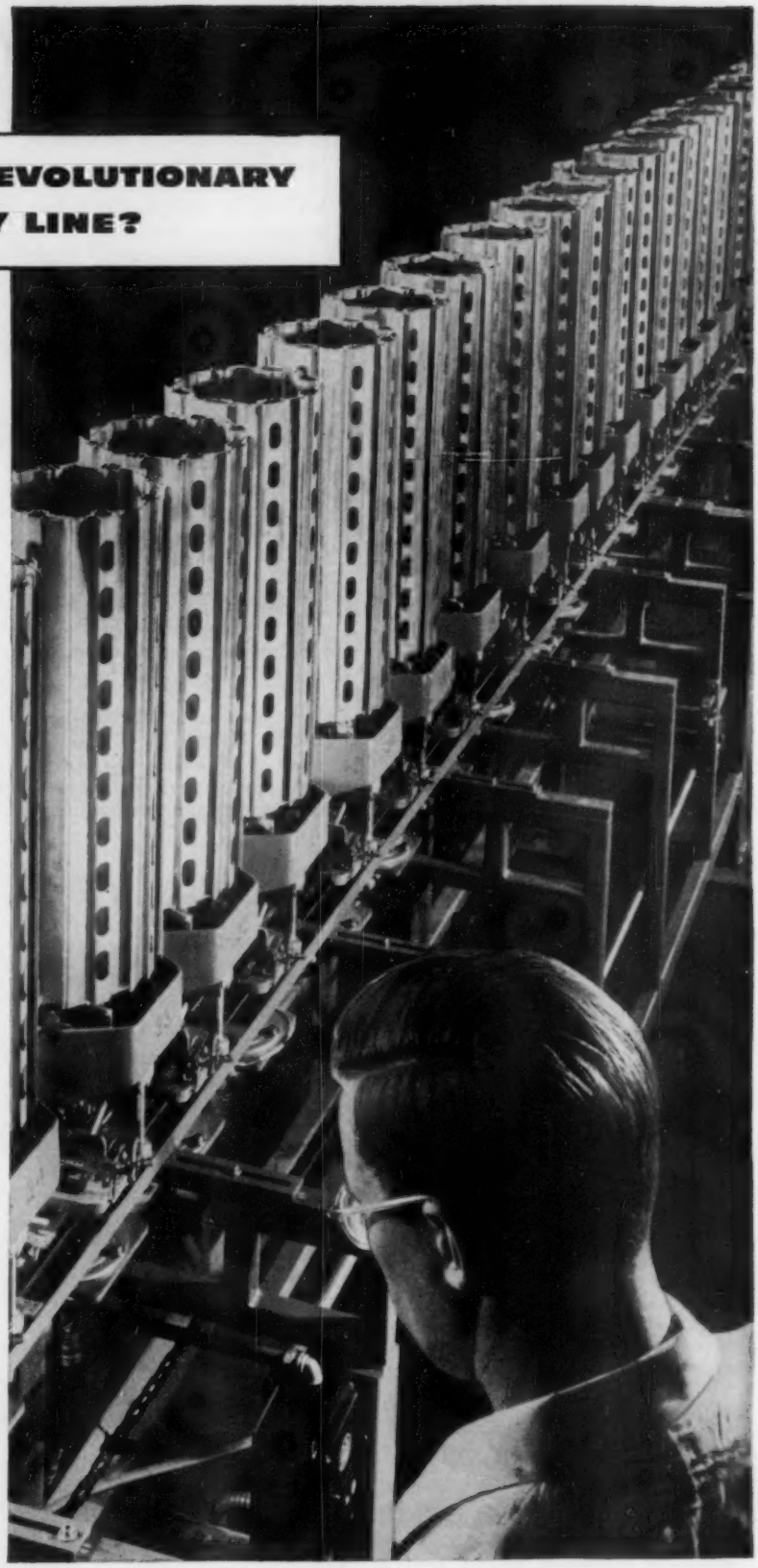
Autofab's first assignment is defense work. It's helping IBM build huge air defense computers for the Air Force faster and at less cost. But other units will soon be available for assembling printed circuits used in radios, television sets and other electronic products.

Autofab is another example of the creative engineering and precision craftsmanship found at the Mechanical Division of General Mills.



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Washington Roundup

Three Profit Probes

Three committees of Congress—each with a different approach—are proceeding with defense profit investigations likely to put the aircraft industry and other military contractors in the public limelight before the end of the session.

These are:

• **House Armed Services Investigating subcommittee,** headed by Rep. Edward Hebert, has already launched an investigation of profits of aircraft prime contractors. Studies of the contracts of six companies—equally divided between production and research and development—are under way. Hearings are contemplated in May. This group's approach is on an individual contract basis, according to John Courtney, counsel.

The aircraft industry has been selected for first attention because it represents the largest segment of defense contractors. Courtney said that the subcommittee may later focus attention on electronics and other defense firms.

• **House Appropriations Committee** will announce an investigation of Defense Department procurement policies when the Fiscal 1956 defense budget is brought up for action on the House floor early in May.

Members of this committee believe that high prosperity of firms with defense business means the government is getting poor bargains in contracting.

"To put it very bluntly, we want to find out why the government is getting skinned," Rep. George Mahon, chairman of the Appropriations subcommittee on the Air Force, commented.

"Negotiated procurement is the big area where we can make savings in the defense budget. We can't cut out soldiers' pay. Competitive bidding takes care of profits on contracts for mops and brooms. But in fields like aircraft and guided missiles, the department just goes out and negotiates a contract. If we had some sharp business people, really working at it, I am sure we could save millions on negotiated contracts. . . .

"The profits of big businesses with defense work are soaring sky high. There must be a reason for it. The reason seems to be that the government does not come out the victor in most of these negotiated contracts. The Renegotiation Act must be continued, but it is not the whole answer."

• **Senate Banking and Currency Committee,** headed by Sen. William Fulbright, is awaiting a list of the 100 firms with the largest amounts of defense business before deciding on further action.

This committee's interest is to determine the effect of defense business on the financial position of firms and the repercussion on the stock market. The committee requested the list of large contractors several weeks ago, but has been informed by Defense Department that it will take at least another six weeks to compile the information Fulbright wants.

New Materiel Chief?

Leading candidate to succeed Lt. Gen. Bryant L. Boatner as Air Force Deputy Chief of Staff for Materiel is Maj. Gen. Clarence S. Irvine, now Deputy Commander for Production, Air Materiel Command. Irvine is chief trouble-shooter for AMC's commander, Gen. Edwin W. Prawlings. A command pilot, he flew the "Pacusan Dreamboat" when that B-29 went nonstop from Honolulu to Cairo in 1946. Gen. Boatner, who became ill on a recent trip to Germany, has been ordered by his doctors to cease strenuous activity, is expected to retire shortly.

Fare Increase Out

Chances for passenger fare increases for the airlines are doomed, at least for the foreseeable future. Recent remarks by airline officials that fare increases are needed to cure narrowing profit margins are lost in the deluge of revenue and traffic increases experienced in the past six months. Civil Aeronautics Board Chairman Ross Rizley dropped the remark at his press conference that airlines reports showed things may look so good the airlines "will want to reduce rates to get more people to ride."

CAB Security

Efforts are being made to tighten up security in the Civil Aeronautics Board in the face of growing concern over information leaks. Chairman Ross Rizley has circulated a memorandum to the staff warning against unauthorized, improper or premature disclosure of information. Rizley has expressed concern over "violation of the quasi-judicial function of the Board," while favoring release of all information not in violation of the law.

Rizley released the memo at a press conference last week, the first held by a CAB chairman since early in 1952.

He said he had a "heart to heart talk with the other Board members and department heads on security, and his memo points out to the staff possible consequences of leaks, which could lead to dismissal.

A basic problem in Board security has been leaks on cases which must go to the White House for approval. The problem is complicated by the fact that decisions which go to the White House are also circulated through Departments of Commerce, Post Office, Defense, the Bureau of the Budget and other agencies, increasing opportunities for leaks.

Airline Subsidy Money

There is now a good chance Civil Aeronautics Board will be voted the full $15.2 million it requested to finance subsidy payments to airlines to July 1. The House cut the amount to $5 million. Senate Appropriations Committee, however, restored the $10.2 million cut, approving the full $15.2 million.

Renegotiation Action

The outlook is for quick congressional action on legislation reviving the Renegotiation Act and making it retroactive to Jan. 1, when it expired. House Ways and Means Committee plans consideration soon, may by-pass time-consuming open hearings and simply vote on renewal legislation after executive consideration. Secretary of the Air Force Harold Talbott is one of the strongest supporters of renewal. Secretary of Commerce Sinclair Weeks, it is understood, is opposed, but his position was overruled when the President formally requested Congress to continue the new renegotiation law (AW Mar. 28, p. 15).

—Washington staff

AVIATION WEEK VOL. 62, NO. 16
APRIL 18, 1955

AMC Comptroller Warns Industry:

Production Methods Lag Behind R&D

By William Coughlin

Los Angeles—U. S. production methods are not keeping pace with rapid advances in research and development. As a result, the nation is designing air weapons which it cannot produce.

This warning came last week from one of the top officers of the Air Materiel Command, Maj. Gen. P. W. Smith, in an address before the aviation committee of the Los Angeles Chamber of Commerce.

The AMC comptroller confirmed that two fields vital to the operation of new air weapons are in serious production difficulty:

- **Jet engines.**
- **Avionic equipment.**

"The fact is that we have some magnificent designs, but in too many instances we cannot produce them with the functional quality we need at a price within our budget, in effective quantity, on time," Smith said bluntly.

▶ **Too Optimistic**—Persistent falling back from one production goal after another indicates that the industry—Air Force partnership may be developing a dangerous blind spot in production engineering, he declared.

"A great majority of industry has been over-optimistic, in all honesty and sincerity, in making commitments for the new weapons," he said. "Again and again they cannot meet the production schedules which they themselves have accepted."

Major reason for this is the lack of realistic assessment of the production methods which are a prime factor in production potential, the general said.

"In the long run a weapon is only as good as its production base," he said. "The storm warnings on this have been up ever since we began the concentrated Air Force buildup at the beginning of the war in Korea."

It has been taken too much for granted that the U. S., where mass production was born, need have no worries on the score of production methods, the AMC officer charged.

Gen. Smith warned that the lag in production methods may cancel the edge in weapons superiority over the communists that research and development has won for the U. S.

"Some Air Force contractors have been facing the problem squarely and solving it," he stated. "Their success shows up on the production schedules, in the unfailing reliability of their products. Many, however, have apparently not even defined the problem, much less taken action to meet it."

▶ **Lowest Denominator**—Due to the high degree of interdependence among contractors, the general pointed out, production tie-ups in any one of innumerable component or equipment fields can stall a whole weapon system, or cancel out the reliable performance of its mission, thereby holding production to the lowest common denominator.

"I think the answer to that lies in raising the over-all level of our production engineering," he said.

Smith defined production engineering as the process by which a device is developed from the research prototype to the actual production model, and by which the production processes to be employed are then established.

Urgency of requirements for an Air Force-in-being has meant thus far the channeling of almost all available resources into actual production rather than production planning, Smith said.

"Industry has had to 'make do' in many instances to get the planes that are today's defenses into the air," he remarked. "Our major concern now must be to insure that this does not become a production habit with us."

▶ **Suggested Solution**—To combat the lag in U. S. production methods, Gen. Smith suggested:

- **As liberal an exchange** as possible of manufacturing know-how within industry and within the trade organizations which represent it. "Let's use all the common sense we have in distinguishing between trade secrets and the share of know-how that can benefit our common cause."
- **Concentration** by individual management upon a firm program of retiring outmoded methods while encouraging creative and foresighted thinking on production techniques. This will require a definite budget allowance for adapting and experimenting in the production field with whatever promising new developments become available.
- **Increased recognition** by management of the production engineering function and of the production engineer as a part of the management team.

Gen. Smith said production engineers should be selected for "that creative spark which can see new ways of making a better product faster and more cheaply."

He said the production engineer should be trained until he knows existing operations inside out and should be given the solid backing of management in keeping production going.

▶ **Bright Spots**—The general cited a number of examples of excellent production engineering in the industry, including developments in optical tooling, highspeed milling, steel and titanium extrusion, new sheet metal forming techniques, rolled tapered sheets, the use of castings, design of machine tools for aircraft needs, and the reduction in use of critical materials.

"But this high standard of performance is not widespread enough," he charged. "It comes again and again

Home Owners Sue Lockheed

Los Angeles—A trial which will be followed closely by airlines, airframe manufacturers and the military opened in Superior Court here last week.

The plaintiffs, 127 home owners, are demanding $960,000 damages from Lockheed Aircraft Corp. on grounds that the "hideous noises" and intense vibrations of Lockheed aircraft operating from San Fernando Valley Airport made them ill and nervous. Decision will be one of the first legal rulings on the question of airport noise.

The complaint charges that for the three years ending last July, when Lockheed transferred testing operations to Palmdale, both jet and propeller-driven planes were flown over properties surrounding the airport about 30 times a day at altitudes ranging from 25 to 700 ft. and at speeds from 150 to 500 mph.

Lockheed denies that the homeowners suffered any damage.

from the same few who are at the head of the class. They cannot carry indefinitely the whole burden of our industrial progress."

The new weapon system approach to Air Force procurement will help smooth the way for better production engineering, Gen. Smith said, because production engineering can begin at an early design stage. Necessity for radical redesign therefore will be substantially lowered by producibility considerations.

▶ **Air Force Aid**—The Air Force is willing to give whatever assistance is necessary, particularly in those areas where military requirements lay a heavy burden upon industry or where a sharing of resources can yield mutual benefits, he declared. From 1948 to 1953, the Production Resources Division sponsored some 140 projects, ranging from studies of titanium fabrication and production to simplification of design.

Hiller Shows Off Flying Platform

Another flying platform, traceable to experiments by the National Advisory Committee for Aeronautics, was displayed last week by Hiller Helicopters, Palo Alto, Cal. Similar in most respects to the de Lackner helivector (AW Apr. 4, p. 7) and developed as a research tool for the Office of Naval Research, the Hiller machine is supported by a ducted fan, two contra-rotating propellers. There are two engines supplying together less than 100 hp. The device is steered by leaning in the direction in which the pilot wants to go.

Wilson Warns Contractors on Security

By Claude Witze

Defense Department contractors soon will be asked to curtail their public information activities, with particular emphasis on the data disclosed in their advertising, according to Defense Secretary Charles E. Wilson.

Wilson's decision was disclosed last week at a Pentagon news conference called for discussion of his recent orders curbing military spokesmen and demanding that the armed forces reduce their public information staffs (AW Apr 4, p. 11).

▶ **Control Powers**—The secretary said his orders are "intended to improve a recognized unsatisfactory situation" which is resulting in provision of "so much information about the performance and capabilities of our new weapons" for potential enemies.

Wilson made it clear that contractors "will be asked to co-operate" and indicated the department has more power to control them than it has over the press because "they are obligated" to the government.

He did not cite specific instances of indiscretions by industry but said an enemy can get "astonishing information out of advertisements" and that "there are people who try to show how much they know . . . in some cases they talk too much."

Wilson also said: "We have been putting out technical information which our top people feel we should not be putting out." He did not name the "top people" but it is known that President Eisenhower has strong convictions on the subject.

▶ **Hard To Define**—Most of the news conference questions about Wilson's directive centered on its requirement that an item cleared for publication not only has to pass security rules but also must make a "constructive contribution" to the Defense Department's mission.

The secretary said this is "a little hard to define" and that questions of "propriety and policy" are involved as well as secrets. Asked if this was not the same standard imposed in countries behind the Iron Curtain, he replied: "My standards are different than theirs, so don't worry about that."

Another reporter pointed out that the new Wilson directive is similar in many respects to one promulgated by Defense Secretary James Forrestal in 1949. Wilson said it is similar, but that collapse of the Forrestal program did not mean that the program will not work in 1955.

▶ **Central Review**—He asked the press repeatedly to "allow a little time" for the confusion to quiet down and expressed confidence that his orders will "clear up our problems."

The secretary said that a general tightening of classifications will be undertaken and that the program to do this and enforce the program will be in the hands of his new Assistant Secretary for Legislative and Public Affairs, Robert T. Ross. Ross replaced former Sen. Fred Seaton in this post last month.

Wilson declared that he does not expect many questions involving "constructive" material will come to his desk once his program is under way, although "it was recognized that in order to have uniform policies such review would have to be done centrally."

▶ **Military Reaction**—Since distribution of the directive, newsmen and some contractor representatives have had difficulty getting information. Reaction of uniformed information officers in the Army, Navy and Air Force has been to shun responsibility for deciding what is "constructive" and pass all material along to the Defense Department for approval.

Wilson denied that this was the intent of his order and said there is no reason why routine queries should not be handled in the routine way.

First branch of the service to put out its own directive carrying out Wilson's order was the Army. Army Secretary Robert T. Stevens told field commands they must get prior approval of the Pentagon before releasing information that deals with anything but local matters.

▶ **Testimony Trimmed**—The standards under which information will be denied were not noticeably clarified by Wilson. At one point he said he would forbid the Pentagon to co-operate with a reporter working on a story not

Marquardt Growth

Remarkable phenomena of the booming U. S. aircraft industry are the new companies which have come to the top during the post-World War II decade. One with an outstanding record is Marquardt Aircraft Co., Van Nuys, Calif., a leader in the development of ramjets, afterburners and reverse thrust devices. On page 43, Irving Stone, one of Aviation Week's senior engineering editors, starts a series of articles on Marquardt's growth and its products including supersonic ramjets for guided missiles.

The Pentagon Run-Around

Illustrating difficulties of newsmen to get information from the military services is a log of calls made by Aviation Week's Military Editor trying to check a new Army contract. He started by calling H. E. Miner, Office of Technical Information, Office of the Army Chief of Engineers. The trail followed these turns:

• Miner says he no longer is permitted to answer queries from the press, refers the inquiry to Orville Splitt, Magazine and Book Branch, Office of Public Information, Department of Defense.

• Splitt is absent on temporary duty at the White House. His assistant is unable to help, refers the query to Lt. Col. J. G. Chestnutt, Deputy Chief, Public Information Division, Office of the Army Chief of Staff.

• Col. Chestnutt says he can see no reason why the Army Engineers should not supply the information. He will call Miner and instruct him to do so.

• Miner says he has a written order saying all queries must be referred to the appropriate individual in the Defense Department's Office of Public Information. He says the order is signed by Lt. Col. H. D. Kight, chief of the Army's Public Information Division. Col. Kight is Col. Chestnutt's immediate superoir.

Pressed at this point by the fact that the reporter has been around a complete circuit with no results, Miner says he will look into the situation and call back. He refers the reporter to B. P. Wilkerson at the Army Map Service, an organization under the jurisdiction of the Army Chief of Engineers.

• Wilkerson says he has instructions to give the requested information. It is that Rick Helicopters, Inc., San Francisco, has been awarded a contract to supply three aircraft for a mapping project in Iceland. The company is guaranteed 900 hours of flying on the job, for which it will be paid $109 an hour.

viewed as "constructive." He indicated an example of this might be an article on such an issue as the controversy over the relative merits of the B-36 bomber and the Forrestal-class carrier.

Neither did the secretary give any details on how he planned to have Ross handle the classification of material "a little differently." Only indication of how this may work was a report that material had been censored out of a statement prepared by Gen. Nathan F. Twining, USAF Chief of Staff, for a congressional committee. The facts, involving the Falcon missile, are not classified and were used earlier in a cleared speech by Trevor Gardner, USAF Assistant Secretary for Research and Development.

On Capitol Hill last week, Congress was in recess but Sens. A. S. (Mike) Monroney, a Democrat, and Francis Case, a Republican, both former reporters, criticized the Wilson directive. Monroney suggested the help of working editors should be sought to draw up a practical program that would not gag the press but would protect national security.

▶ **New Officials**—Ross, Wilson's assistant now in charge of the effort, is a former member of Congress from New York City, assistant to the chairman of the New York Republican State Committee and liaison man for that group with the Republican National Committee and the White House.

Ross has had business experience with two firms that manufacture clothing and athletic equipment and for three years was special assistant to the president of the Liggett Drug Co.

Early this month, Philip K. Allen was sworn in as executive assistant to Ross. Allen had been chief clerk of the Senate Armed Services Committee since 1953. He is a former Republican member of the Massachusetts State Senate. He served five years in the Army. His other experience includes work as a teacher and coach at Cambridge School and Phillips Academy, assistant counselor for veterans at Harvard University and assistant to the dean of admissions at Harvard. For two years he was executive secretary of the Massachusetts Republican State Committee.

▶ **Swan Resigns**—Until early this month, D. Walter Swan, assistant to the president of United Air Lines, was serving as deputy to Ross for public affairs. Swan has returned to UAL and the position is vacant.

Speculation last week was that this vacancy may be filled by R. Karl Honaman, director of Commerce Department's Office of Strategic Information.

Honaman, formerly of the Bell Telephone Co., is known to have a presentation showing how material reaches the enemy. Like Wilson, he knows none of the facts are classified but feels they still should not be printed.

New Connies

Trans World Airlines is operating its new Super-G Constellations in daily nonstop service between Los Angeles and New York. The 66-passenger first class flights have been flying with load factors in excess of 60% since service was inaugurated Apr. 1. Chicago, St. Louis and Kansas City will be added to schedules within ten days, and San Francisco soon after. Use of the Super-G on international routes isn't expected before autumn.

The Super-G, with a sleeper section of eight berths, gives TWA the only coast-to-coast sleeper service. Ten of the new aircraft will have been delivered by the end of April, and the remaining ten will be delivered by midsummer.

Small Business Rule Under Investigation

Protection offered small business in defense mobilization plans will be investigated within the next two weeks by the Senate Committee on Small Business.

Witnesses will include Defense Secretary Charles E. Wilson and Defense Mobilization Director Arthur S. Flemming. They will be questioned about plans to maintain the mobilization base and how the interests of small business are guarded in procurement rules.

Wilson is expected to explain his directive of last December ordering Defense Department procurement officials to broaden the base even at the expense of paying premium prices where necessary (AW Dec. 27, p. 15).

▶ **Price Differentials**—So far, only the Air Force has implemented the directive, No. 3005.3, with a procurement circular designed to expedite the program. The circular is applicable to all negotiated contracts.

USAF policy, the new rules say, is to approve "justifiable price differentials . . . to accomplish the objective of broadening or maintaining the industrial base of suppliers."

Spokesmen for USAF say the new procurement circular (No. 10) does not change existing regulations but codifies the rules and brings them into one place where they cannot be overlooked by procurement officials.

▶ **Contract Criteria**—The circular says USAF will select for its mobilization base those facilities which meet these criteria:

• Requiring a long lead time or long manufacturing cycle.

• Not currently in production or which are required in quantities far in excess of peacetime production.

• Requiring the conversion of an industry or number of plants within an industry.

• Requiring materials or manufacturing processes essentially different from those in current use.

• For which industry does not have production experience.

Maximum utilization of small business also is demanded to help maintain

Fiat Fighter Wins

Department of Defense last week confirmed Aviation Week's report (Apr. 11, p. 11) that the Fiat Co. of Turin, Italy, had won the NATO competition for a lightweight fighter.

Negotiations with Fiat for three prototype GA-91 lightweight fighters and a production quantity of 27 planes will be conducted by headquarters of U. S. Air Forces in Europe. This program will be financed from the $100 million mutual weapons development fund. Pentagon said the Fiat contract would involve "several millions."

Fiat will also get another $9 million contract for assembly of additional North American F-86K all-weather interceptors and has been picked to do repair and overhaul work on the General Electric J47 turbojet engine used in the F-86K and F-86F fighters scheduled for widespread use in NATO air forces.

a sound mobilization base, along with these factors:

- Maintaining multiple sources of supply.
- Geographic dispersal.
- Avoidance of undue concentration of contracts in a few leading suppliers.
- Multiple awards.
- Preservation of essential skilled labor forces.
- Utilization of existing open industrial capacity.
- Preservation of essential management organization of know-how.
- Maximum subcontracting.

Definition of geographic dispersal is given as insurance that facilities are 10 mi. or more from a densely populated area of 120,000 or more, a highly industrialized area or a major military installation.

Innovations Aide

Air Research and Development Command's Analysis and Evaluation Office has a new Assistant for Innovations, Lt. Col. M. W. Beardsley.

His job: to look at new and revolutionary ideas that may contribute to dramatic strides in Air Force development. When an idea has merit, he will act to speed contact between the inventor and ARDC experts who are interested.

The new office is intended to help persons not already doing business with USAF through regular channels. Lt. Col. Beardsley can be reached at ARDC headquarters, Box 1395, Baltimore 3, Md.

Russia Developing Mach 20 IBM

Los Angeles—Within 10 years, Russia will be able to launch an intercontinental ballistic missile in the Mach 10 to Mach 20 range (8,000 mph. to 16,000 mph.). It will hit any target in the U. S. in not much more than 30 min. after firing.

Closer is a Russian cruising missile with speeds in the vicinity of two to three times the speed of sound that will put the enemy within a few hours of most major U. S. cities.

This report was made last week by Gen. Benjamin W. Chidlaw, commander of the Continental Air Defense Command, before the Management Club of Hughes Aircraft Co.

▶ **Offensive Strength**—"Before the end of this same decade," he said, "we are probably going to be well into the ballistic missile era."

Improvements in the U. S. defense system are being offset by developments in offensive strength behind the Iron Curtain, the ADC commander warned.

Development of long-range bomber force, followed by increased missile capability, means the Soviets are not far away from the ability to attack the U. S. day or night in any and all kinds of weather, Gen. Chidlaw warned the meeting.

▶ **Interceptor Projectiles**—The USAF general said intelligence reports of these Soviet developments meant this: "We had to think immediately in terms of interceptions which could be made in minutes and miles up—new kinds of projectiles with increased deadliness and decisiveness—and some means of coming on target instantly, accurately and so destructively, day or night, in all weather that no condition of utmost favor to the attacker was able to put him out of our reach to bring him down . . .

"It is no news to you that your organization got the job of building the mechanical brain which would give us the capability for now. And it is to your everlasting credit that you brought it along in production in timely fashion."

▶ **Rocketry Program**—Chidlaw admitted the new rocketry program and fire control mechanism ran into strong opposition in the Air Force.

"Such was the tendency to resist that when we went into the first Air Force-wide, air-to-air rocketry competition in Yuma, Ariz., in June last year, frankly the jury was still very much out on the wisdom of our having converted Yuma from a conventional gunnery center to rocketry in 1953."

Results of the Yuma meeting were decisive in changing this thinking, General Chidlaw said. "It is now the opinion that the showing in Yuma actually lifted the rocketry program and led collision course firing forward a full year in emphasis." (Gen. Chidlaw confirmed here what AVIATION WEEK reported from Yuma last year at the conclusion of the rocket meet.)

Since the initial competition at Yuma, USAF has added another rocketry proficiency center for air-to-air activities at Valdosta, Ga., the ADC commander said.

"In the not-too-distant future, we will have all but a few of the fighter-interceptors in the Air Force ready to go in air-to-air rocketry employment."

AIA Calls Pullbacks Matter of Survival

Los Angeles—It can be a matter of survival for a prime contractor to return work from a subcontractor to his own plant, according to L. D. Webb, vice president and western regional manager of the Aircraft Industries Assn.

▶ **Pullback Reasons**—Speaking before the Industrial Manufacturing Services Corp. last week, Webb said primes often are criticized for pullbacks that are necessary. These are some of the reasons for pullbacks:

- Failure of suppliers to meet schedules, quality or price.
- Inability of prime contractors to estimate work loads more than a year in advance due to the nature of the aircraft industry.
- Certain laws of economics that face the prime contractor. Failure to recognize these often leads to criticism of the prime by the subcontractor.

▶ **Prime's Dilemma**—"If his load falls off, he is faced with a dilemma," the AIA official said. "If his subs are efficient low-cost producers, then the return of some work to his own plant increases the cost of making those items.

"On the other hand, leaving it alone increases his own overhead costs."

Webb cited this example: If a prime contractor had an overhead rate of 150% and employed 10,000 persons before his schedule was reduced and then cut his force to 5,000, his direct labor would be reduced by 50% but his overhead rate could go as high as 255%.

"Such a situation could increase a prime contractor's costs to the point where he could price himself out of business.

"It is therefore important to keep his direct labor force as high as his work load will permit. To do this, it sometimes is necessary to pull subcontracts back from the subcontractors into the prime plant."

British to Improve Bomber Range, Mobility and Accuracy on Target

London—New technical developments aimed at providing longer range, greater mobility and improved bombing accuracy for Britain's new subsonic strategic striking force of V-bombers were revealed during a recent Parliamentary debate on the military budget.

Among the new improvements planned for the Vickers Valiant, Avro Vulcan and Handley Page Victor are:

• **Aerial refueling kits.** These kits are being designed to convert the V-bombers quickly into tankers capable of aerial refueling of other bombers for long-range missions. No details of the jet tanker kits were given but they are believed to be similar to the type of equipment being developed by the U. S. Navy for its "buddy system" concept for increasing the range of carrier-based striking forces.

• **Rocket-assisted takeoff.** A de Havilland Sprite cold rocket kit designed to boost the Valiant on takeoff has already been publicly displayed. It is jettisoned after takeoff and recovered by parachute. Similar installations are apparently planned for the Vulcan and Victor to enable these bombers to use a wide variety of smaller fields rather than tie them to a few bases with special runways.

• **New navigation and bombing systems.** One new navigation and bombing system has been developed since 1948 and is now in production. Another new navigation system has been developed "utilizing entirely new principles" and is in production.

Undersecretary of State for Air George Ward said the creation of the V-bomber striking force with its atomic and hydrogen weapons stockpile had top priority in Royal Air Force planning. He said the first squadron of Valiants has been organized and a second squadron is forming. The Valiant has a better performance, according to Ward, than the Boeing B-47, of which 1,200 are now in service with Strategic Air Command. Both the Vulcan and Victor have demonstrated performance well above 50,000 ft. and at high subsonic speeds, he said. The Vulcan is expected to get into squadron service in 1956.

▶ **Mobility Plans**—Britain plans to develop Middle East and African bases for its strategic striking forces to give them dispersal and mobility sufficient to prevent a crippling enemy attack on the bases at home. Bombing ranges are also being planned for the African desert, and a new radar plotting technique will enable recording of bombing accuracy on drops made far out at sea. Canberra squadrons are being rotated through the Middle East base complex in a manner similar to the shifting of USAF bomber wings to North African, English and Far Eastern bases.

Although there are 11 projects aimed at supersonic aircraft development under way in Britain, there is no specific project for a supersonic bomber. Ward said the RAF is taking delivery on atomic weapons and storing these weapons at key locations. Debate also revealed that the strategic striking force would not reach an effective strength until the end of 1956 and that it is programmed to maintain and support a first line strength of about 100 bombers.

Flight simulators are being built for all three V-bomber types, with the first Valiant simulators ready for operations soon.

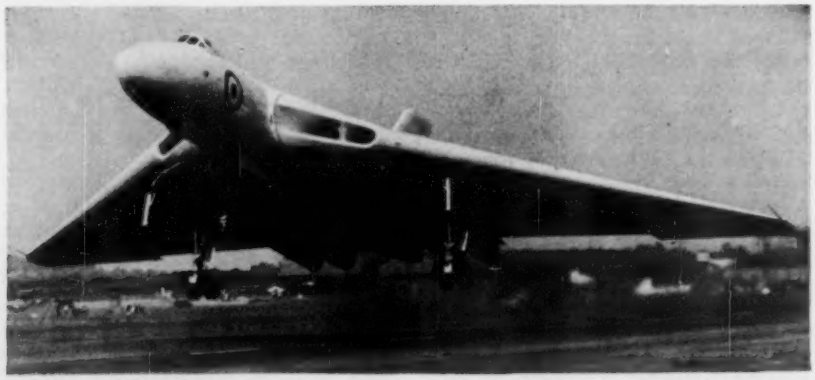
▶ **Production**—British aircraft industry produced a total of 6,000 aircraft and 12,300 engines between November 1951 and March 1955, of which about 200 were Hawker Hunter fighters and about 750 were jet trainers. Original orders for more than 1,000 Venom fighters were cut by 750 planes, and the Canberra bomber program was slashed from 1,200 to 800 planes. The "Plan H" of Royal Air Force development in force before 1952 called for a front line strength of between 3,000 and 4,000 aircraft but current plans set the RAF first line combat aircraft well below that figure.

The subsonic Gloster Javelin delta-wing all-weather interceptor is still beset with development problems, but "these can be solved within the limits of current aeronautical knowledge." Ward confirmed AVIATION WEEK's prediction (AW Dec. 13, p. 11) that the Javelin will be armed with an air-to-air guided missile in addition to its four Aden 30-mm. cannon. A later development of the Javelin has been ordered in a pre-production batch of 18 planes. This version will feature a thinner wing and Olympus engines replacing the Sapphires for more speed and better altitude performance.

Other developments revealed in the debate are:

• **Hunter trainer** is in the works with a tandem seating arrangement.

SEASLUG is the Royal Navy's new ship-to-air guided missile. Note tail booster rockets.



SECOND PROTOTYPE Avro Vulcan shows new bulge under nose for bomb-aiming radar.

This two-seater will be used as an advanced trainer in the all-jet RAF flight training program.

• **"Rotor Project"** has completely revised Britain's early warning radar and fighter control network with better equipment and underground control centers. This net will provide only 10 min. warning for British cities.

• **Eight Comet II's** will be modified for service with the RAF Transport Command. They will be used to carry freight until an airworthiness certificate is obtained for passenger travel. It is expected that these Comets will be used on a high speed shuttle between England and the Woomera missile test range in Australia.

• **Joint experimental helicopter** unit will be organized by the RAF and British Army to develop copter techniques for both services.

• **New anti-submarine warfare** helicopter is under development.

• **Current anti-aircraft missiles** developed in U. S. and Britain have too short a range to be effective against jet bomber attacks. Britain is concentrating on development on an anti-aircraft missile system that will bring down an enemy bomber well out at sea before they reach the British Isles. Only one missile has been ordered into production—an air-to-air missile believed to be the de Havilland infra-red guided rocket.

Automatic System Sends Weather Data

An electronic data processing system to speed transmission of weather information to aviation facilities is in trial operation over a 10-station network extending from Indianapolis to Washington, D. C. Developed under Air Navigation Development Board sponsorship, it may be the prototype of a nation-wide system for automatic handling of weather and flight plans.

Heart of the system is a large magnetic "memory" drum, and automatic teletype switching station, both located at Indianapolis. Latest weather report will be stored on the drum, and automatically transmitted periodically via teletypewriter, giving each facility only the weather information it normally requires. If a station wants more data on other geographic areas, it uses its teletypewriter to interrogate the Indianapolis storage drum.

The 10 facilities tied into the present evaluation network include: Weather Bureau stations at Indianapolis, Dayton, Columbus, and Pittsburgh; the Civil Aeronautics Administration station at Zanesville, Ohio; USAF stations at Dayton and Olmstead Field; the Naval Air Station at Columbus, Ohio; and Capital Airlines at Pittsburgh.

Collision Warning Instrument New Avionic Need of Airlines

Air Transport Assn. has challenged the avionics industry to come up with a proximity warning indicator, a new device to warn pilots of collision threats from nearby aircraft whose course and altitude present a collision threat. The device must show instantly what evasive action is necessary.

Requirement for the proximity warning indicator stems from growing airport and airways traffic density that is not patrolled now by air route traffic controllers during VFR conditions. The device also should prove useful during IFR conditions.

The problem of collision exposure "is growing much too rapidly for peace of mind," one airline official says.

▶ **Airline Interest**—First public disclosure of airline requirements for the proximity warning indicator came from David S. Little during Spring Assembly meeting of the Radio Technical Commission for Aeronautics in Los Angeles.

Little, superintendent of airways aids and electronics for American Airlines, heads the ATA VFR Committee that drafted operational requirements for the device.

Little called on the avionics industry to apply its technical ingenuity to the problem and to develop suitable equipment, although he indicated the airlines were not yet ready to commit themselves to fleetwide installations.

▶ **What Is Needed**—Operational requirements for the proximity warning indicator, prepared by a group of airline operations and electronics experts, call for the following:

• **Detection** of all aircraft within a radius of 10 miles during cruise conditions (three miles while in a holding pattern) and within plus or minus 800 feet of the airplane's altitude—and possibly up to plus or minus 5,000 feet. If complete spherical coverage is not feasible, the forward hemisphere is considered the more important.

• **Display** of all aircraft within detection range, showing their direction, altitude and distance.

• **Warning** by audio means, whenever another aircraft "penetrates" pre-selected perimeters, of altitude, range and/or bearing. Although all aircraft within detection range would be displayed, ATA would like pilot alerted only when another aircraft's bearing, distance and altitude present a hazard.

This collision possibility would be determined by a small trigonometric computer calculating what ATA calls "the collision triangle." ATA believes this added complexity is desirable so as not to annoy the pilot with needless warnings under high density conditions.

▶ **Radar To Smoke Trails**—ATA lists more than a dozen different possible technical approaches the industry might use to solve the problem. These range from a super-high-frequency radar to vapor or smoke trails and from infra-red detectors picking up engine radiation to the use of radioactive materials and detectors.

ATA believes many of these will be quickly rejected as impractical, and centers its attention on two generic radio types:

• **Independent,** requiring no active equipment or "cooperation" from target aircraft.

• **Cooperative,** requiring other aircraft to be equipped with some type of associated equipment.

▶ **Independent Type**—ATA believes the most feasible independent type of warning indicator will be an airborne radar operating at a frequency of 10,000 to 30,000 megacycles. (Present airline storm-warning radars operate at approximately 5,400 and 9,200 mc.) These very high frequencies would give sufficient definition to pick out other aircraft, not possible with the lower-frequency storm-warning radars.

Disadvantages of proximity-warning radar, according to ATA, appear to be its high cost, heavy weight and the need for a large external antenna with somewhat critical siting requirements. Added disadvantage is that precipitation reduces the effectiveness of radar.

A simplified radar that shows only the direction of the target aircraft, without indicating its distance, might reduce the cost and weight. But this also would reduce equipment's utility, making it unable to calculate the "collision triangle."

▶ **Cooperative Type**—On the strength of its own limited study, ATV's VFR

Proximity Problem

"As our speeds of operation increase, our closure speeds rapidly surpass that point where the human eye and body are effective in coping with the collision problem. Increasing density of air traffic aggravates this problem. Higher performance aircraft . . . take longer and longer to actually begin a turn after the proper control movements have been accomplished." . . . David S. Little, speaking on the need for proximity warning indicators.

Committee believes that cooperative type proximity warning may prove to be the better system. ATA considers several possible approaches.

One is to use a special transponder beacon, similar to that contemplated for air traffic control use, except that it would operate at a higher frequency. This would enable an interrogating aircraft to obtain a satisfactory bearing accuracy with a relatively small external rotating antenna. The transponder reply would be coded to give aircraft's altitude, as measured by a barometric altitude transducer.

A less costly adaptation might involve a continuous-wave or pulsed transmission from all aircraft (including barometric altitude information). But this would not provide the distance and rate-of-closure information available from transponders. Still another approach is for each aircraft to continuously telemeter to all other aircraft in the vicinity its heading, airspeed and barometric altitude. While this eliminates the external rotating antenna, it complicates the computer design.

▶ **Overly Complex?**—ATA's operational requirements are intended to stimulate industry thinking on the problem.

If they prove incompatible with the need for extreme reliability and dependability, ATA would settle for a less complex device that merely alerts the pilot to the proximity of other aircraft without attempting to assess collision possibility automatically.

Avionics Industry Cautions

Airframe Makers Must Halt Raids

Los Angeles—Airframe manufacturers have been cautioned not to invade the avionics field and warned against attempts to hire engineering talent away from present avionics firms.

H. Leslie Hoffman, president of Hoffman Electronics Corp., charged in a speech before the Radio Technical Commission for Aeronautics that airframe manufacturers expect to double their avionics engineering staffs within the next four years by hiring engineers away from existing avionics companies. This would increase the number of avionics engineers working in airframe plants from 6,000 to 12,000, he indicated. (The figures are based on an exclusive AVIATION WEEK survey, reported in the December 20 issue, p. 44.)

"Frankly we are puzzled as to why some of our friends in the aviation business feel it is necessary to continually expand their electronic activities when the services, facilities and personnel are available for many of these functions within the already existing industry," he declared.

▶ **Reply To Gross?**—Some observers regarded Hoffman's speech as a reply to Robert Gross, president of Lockheed Aircraft Corp., who last month declared that airframe manufacturers must stand firm against loss of air weapons business to outside companies.

Hoffman said the avionics industry has no misgivings about systems engineering or systems procurement—unless it is used as a means of making bigger companies bigger and smaller companies smaller and results in prime contractors drawing to themselves all of the electronics business.

The electronics industry is not overloaded and can handle a great deal more work than it is now handling, Hoffman said in his address.

▶ **Problems Cited**—Among other problems placed before the meeting:

• **An Air Transport Assn.** paper calling for an effective aircraft proximity indicator to reduce the hazard of mid-air collision was distributed (see p. 17).

• **Expanding military** communications needs are fast exceeding allotted frequencies in the overcrowded radio spectrum, Maj. Gen. Gordon A. Blake, director of communications, Headquarters USAF, warned.

There is almost no limit to the amount and variety of new avionics equipment that can be built. The situation is so acute however that "if a manufacturer should devise equipment with the same capability we already have, but which would use much less (of the frequency) spectrum, it is possible that the military would be fully justified in buying the equipment and launching an expensive replacement program solely for . . . the spectrum savings." Some techniques which hold promise of easing the situation include: single sideband, forward scatter (see p. 73), new information theory, improved directional antennas, high-power microwave tubes, and multiplexing.

Swifter point-to-point and air-ground-air communications are also pressing needs, Blake said. Air warning to the military and civil defense system depends upon the simultaneous flow of a great mass and volume of messages.

New teletype equipment and automatic switching centers will speed the flow of information, but even these are not fast enough for modern warfare. "We need a data transmission system which will transmit without the necessity for conversion by a teletypewriter, and can transmit rapidly pictures and maps as well as messages," Blake said. Despite improvements in air-ground-air communications, it is not yet possible to call one specific aircraft without bothering hundreds of others. Jet speeds and all-weather flying require automatic systems of control, via data link, and identification by IFF.

• Gen. Blake reported that the Defense Dept's new system of unsatisfactory reports for avionics equipment, first disclosed by AVIATION WEEK, (Sept. 20, p. 60) will go into effect within the next few months. Each major supplier will be advised quarterly of failures in service of its avionics products.

• An appeal for an industry-wide system of exchanging failure data was made by M. H. Dazey, Northrop Aircraft. Present lack of such a system results in continued use of parts that have been showing scattered failures throughout the industry.

• Avionic equipment reliability and maintainability continue to be major USAF problems, Blake reported. These stem from the speed with which new equipment must be rushed into production to meet jet age demands, and the loss of skilled USAF maintenance personnel.

Defense Dept. studies, cited by Blake, show that approximately 30% of avionic equipment failures result from operational conditions; 30% from manufacturing defects, and other 30% or slightly less because of design deficiencies.

Rand Corp. studies show that USAF spends twice as much yearly on equipment maintenance as its original cost, a figure closely checked by Navy experience.

Electronic System Speeds AF Supplies

Air Force operation of an electronic communications system for ordering supplies began this month between Dayton, Ohio, and Newark, N. J. Substantial savings are expected when world-wide installation is completed.

By reducing the "pipeline" time for ordering "from weeks to hours," USAF points out, the system will permit reductions in supply inventories with resulting monetary savings.

By October, USAF hopes to have 35 points of the system in operation in the U. S. and then will extend overseas.

Heart of the system is the International Business Machines' "transceiver" for transmitting and receiving by electronic impulses over leased telephone lines. Transceivers installed overseas will be linked by radio connections.

Air Force supply orders have been moving by regular and air mail, which requires weeks of time in cases of some overseas installations.

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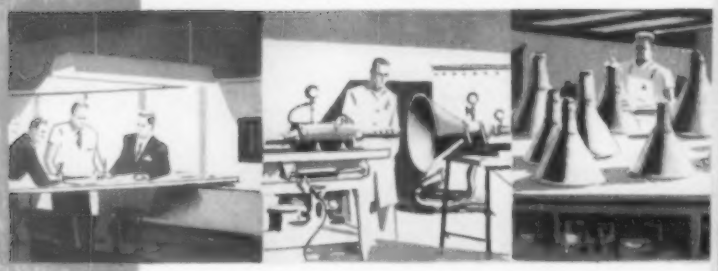

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Turbine Plane Economy Hinges On Outcome of Fuel Controversy

By Gordon Conley

A major controversy is developing over what type of fuel to use in the transition to turbine-powered aircraft. The choice is between kerosene and JP-4.

At issue are safety, economy and availability. If the industry can resolve these points and agree on a standard fuel, oil companies will be able to cut the cost per gallon as they eliminate duplications in supply pipelines.

▶**Civil Future**—The problem now is confined largely to civil aviation, where the choice of fuel may determine the economic future and safe operation of turboprop or jet transports.

So far, only Trans-Canada Air Lines has picked JP-4. TCA decided on the wide-cut fuel, roughly equal to a mixture of 65% low-octane gas fractions and 34% kerosene, after studying the operational requirements of its new Vickers Viscounts in Canada.

British European Airways, Aer Lingus, Trans-Australia Airlines and Capital Airlines selected kerosene for their turboprop-powered Viscounts.

Before the de Havilland Comets were grounded, British Overseas Airways Corp., Air France and Union Aeromaritime de Transport (UAT) used kerosene in their jet transports.

BOAC is expected to continue using this fuel when it takes delivery in 1958 on the first of 20 Comet 4s ordered last month (AW Mar. 38, p. 85).

▶**Military Requirements**—From the military point of view, the choice of a turbine fuel presented no problems. U. S. Air Force and most other members of the North Atlantic Treaty Organization settled on JP-4 because of maximum availability.

But availability probably will give way to technical requirements as more supersonic aircraft become operational. Heat built up by supersonic speeds and rapid reductions in outside pressure during fast climbs can cause JP-4 to boil off.

When these high-performance aircraft outnumber their slower predecessors, the military may be forced to switch to heavier, less volatile kerosene. An alternative is the U. S. Navy's JP-5, basically similar to kerosene but with a higher flash point.

Air and Ground Safety

One of the basic arguments centers on the relative fire risk of kerosene and JP-4. Both can be ignited in flight or on the ground if conditions are right.

Most experts in the aviation industry and spokesmen for major fuel suppliers give the safety edge to kerosene because of its higher flash point of 100F, compared with 10F for JP-4.

But Trans-Canada reports safety was one of the points favoring JP-4 as the fuel for its 15 turboprop Vickers Viscounts. Studies indicated the wide-cut gas retains most risks of high-octane aviation fuels, says TCA's Paul E. Lamoureux, but kerosene has all these hazards plus new ones. The heavier fuel's higher flash point would give only "occasional advantages."

The controversy over safety advantages of the two turbine fuels narrows down to these areas:

• **In flight.** Heat causes JP-4 to boil violently at a relatively low 125F, says Lamoureux. The fuel-air ratio is too rich for combustion if the vapor space is ignited.

"With kerosene under similar circumstances," he says, "the fuel-air ratio above the fuel would go from too lean, through the explosive range, to over-rich as a result of the application of heat. Boiling would occur at a considerably higher temperature (325F) and, should penetration occur during the transition of the vapor mixture through the explosive range, a catastrophe would result.

"A fire is bad enough, but it is better than an explosion. . . ."

Other fuel experts concede that kerosene is sufficientliy atomized to form an explosive mist if escaping at high pressure or if fuel tanks are ruptured during very high rates of deceleration. But they apparently consider the chances of an inflight explosion negligible for kerosene, JP-4 or normal aviation gas.

"There must be explosive mixtures in the fuel tanks during some portions of every flight," one expert says.

Carl A. Weise, chief powerplant engineer for Douglas Aircraft Co., gives these estimated total flight hours for civil transports without a single explosion or fire due to random ignition:

Specification Limits for Turbine Fuels

Specification	Kerosene D. Eng. R.D. 2482	JP-4 Mil-F-5624B	JP-5 Mil-F-7914
Distillation			
10% Evap.	——	——	400F Max.
20% Evap.	392F Max.	270F Max.	——
50% Evap.	——	370 Max.	——
90% Evap.	——	470 Max.	——
E. P.	572 Max.	——	500 Max.
Residue, % v.	2.0 Max.	1.5 Max.	1.5 Max.
Loss, %	1.5 Max.	1.5 Max.	1.5 Max.
Gravity, API	44°	45-55	35-45
Sulphur, % W. Max.	0.20	0.4	0.4
R.V.P. psi	Negligible*	2-3	——
Freeze Point	—40F Max.	—76 Max.	—40 Max.
Btu/Lb. Net, Min.	18,300	18,400	18,300
Aromatics % Vol.	20 Max.	25 Max.	25 Max.
Flash Point	100F	10F*	140 Min.
Viscosity	—6 CS at 0F	——	16.5CS at —30F

*Not specified but represents a typical figure.

DC-3, 150 million hours; DC-4, 11 million hours; DC-6 and DC-7, 3.5 million hours.

• **On the ground.** Some industry specialists and many spokesmen for oil companies believe the danger of fire in crashes is less from kerosene than from JP-4 or high-octane gas.

To back up this belief, they cite the British European Airways' Viscount accident last Jan. 16 at London. The transport was damaged extensively but did not burn. "I think it would have been almost a miracle if there had not been a major fire with gasoline or JP-4," says one British fuel expert.

Pro-kerosene industry members say the fuel's high flash point would suppress or delay ignition long enough for safe evacuation.

"This can be true in the case where fuel escapes after the aircraft comes to rest and spreads on the ground as a quiescent pool," concedes TCA's Lamoureux. But he says recent crash tests by the National Advisory Committee for Aeronautics shows circumstances where high flash point is not an advantage.

"These tests have demonstrated that a common source of ignition during crashes is the hot components of the powerplant," says Lamoureux. "They have also shown that, in the event of wing damage which causes fuel to be lost at the time of the crash when the plane is still moving at relatively high speed, the fuel stream is broken up into a cloud which spreads rapidly spanwise and may even overtake the aircraft as it slows down."

Fuel Economy

Douglas Aircraft's Weise says 83% of a turbojet-powered transport's total operating expense is influenced by fuel costs.

Of this, 40% is direct cost of JP-4 or kerosene. Other factors include:

• **Aircraft, 15%.** Initial cost of an airframe varies directly with the fuel volume and complexity.

• **Engines, 11%.** Volatility, vapor pressure, distillation and cleanliness of the fuel selected for a powerplant are involved in the engine's price. "Fuels as heavy as kerosene apparently cause the engine manufacturer little concern," says Weise, "but the use of much heavier materials as fuel will be very costly in (engine) development."

• **Airframe and engine repair, 17%.** Vapor pressure and freezing point of fuels are reflected directly in the complexity of an aircraft and its powerplants.

This, in turn, has a pronounced effect on manhour repair costs and replacement expenses.

In general, the price per gallon of turbine fuels should increase as its weight decreases because of refining costs. But JP-4 and kerosene leveled off in the U. S. at approximately the same price when oil companies started using the lighter turbine fuel as an outlet for surplus low-octane gas manufactured to autos.

The major factor in fuel cost is transportation, with the price in remote areas nearly doubled what it is at the refinery.

Fuel Availability

One argument for JP-4 is wide availability because of its standard use by the military. But a major international fuel supplier reports kerosene facilities are set up better at civil airports throughout the world than those for JP-4.

Capital Airlines, however, is spending approximately $800,000 to build separate kerosene facilities for its fleet of 60 Vickers Viscounts (AW Feb. 21, p. 77).

▶ **Kerosene Scarcity?**—On the availability of crude oils capable of producing turbine fuels, Trans-Canada says studies reveal relatively few in North America are able to give a satisfactory straight-run kerosene.

"In order to broaden the supply picture, the specifications limits must be altered to some major degree," Lamourcux says. "The freezing point must be raised and, if large supplies are to be made available, the use of cracked stocks must be accepted with all the disadvantages of lower heats of combustion, undesirable aromaticity, etc.

"Combined with this fundamental scarcity of kerosene is the steadily increasing demand for this fraction for other than aircraft uses. . . . If we project this trend ahead a few years, it is obvious that the price of kerosene will increase at a greater rate than the price of the more prevalent wide-cut fuels."

▶ **Progressive Increase**—A. R. Ogston of Esso Export Corp.'s aviation department says there appears to be no justification for airlines to use refinery availability as a major factor in deciding what fuel to use in turbine-powered transports.

"Consumption of fuel by commercial airlines is currently less than 1% of total crude production," he reports. "Even with the considerable expansion to be expected during the next 20 years or so . . . it seems unlikely that the fuel consumed by airlines during this period could exceed 3% to 4%. . . .

"Also, it must be remembered that a progressive increase in the world's production of crude oil will almost certainly continue to develop during the next 20 years."

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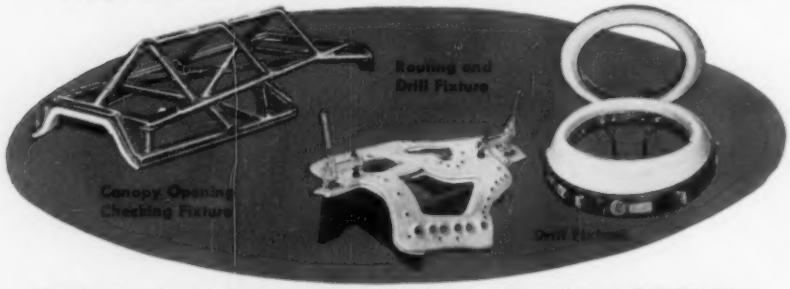

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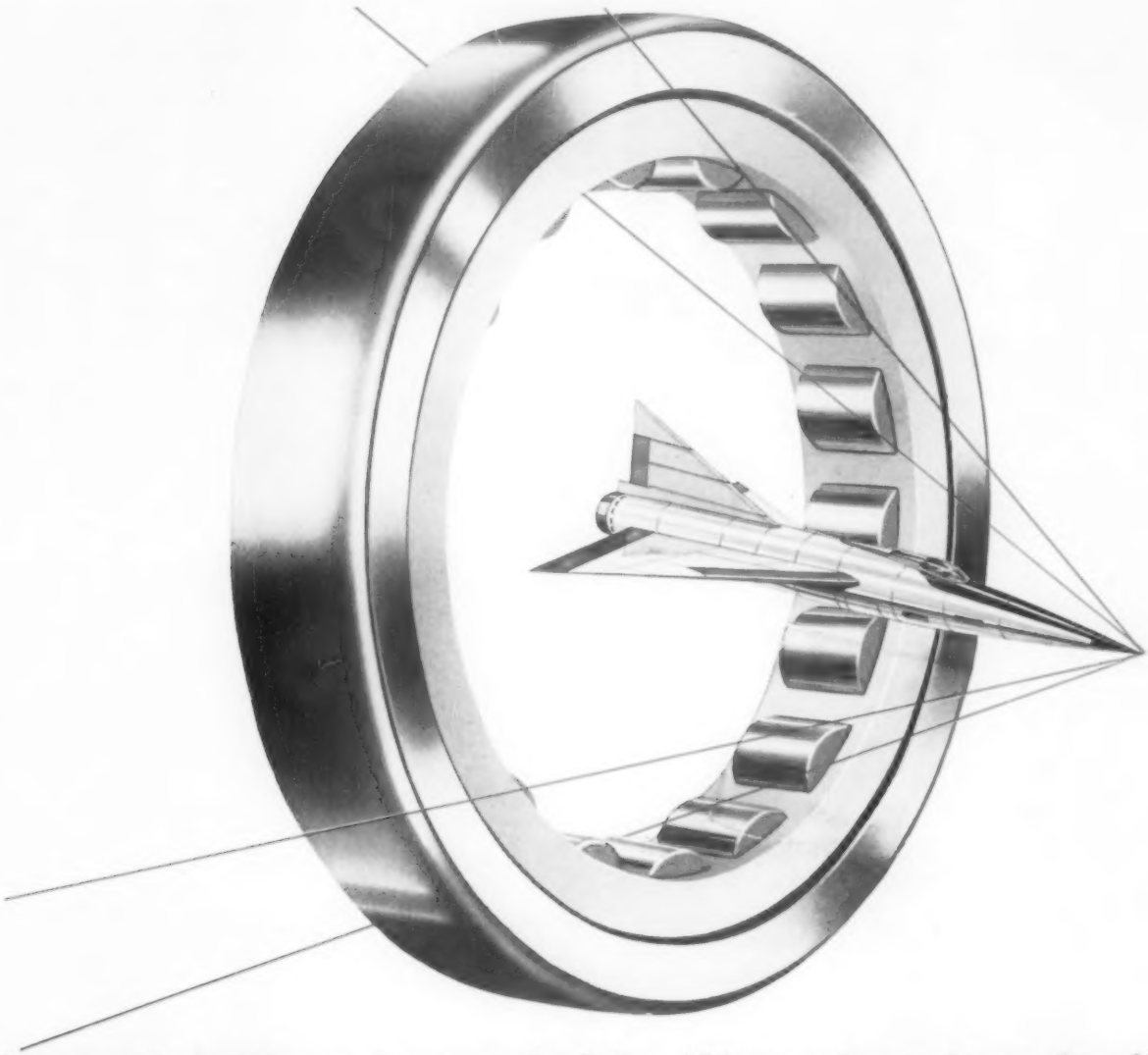

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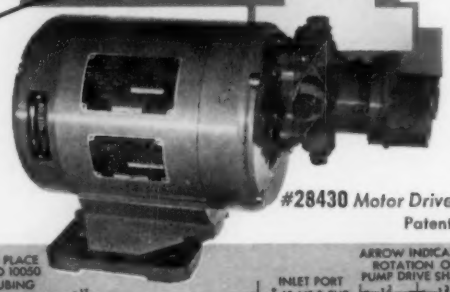

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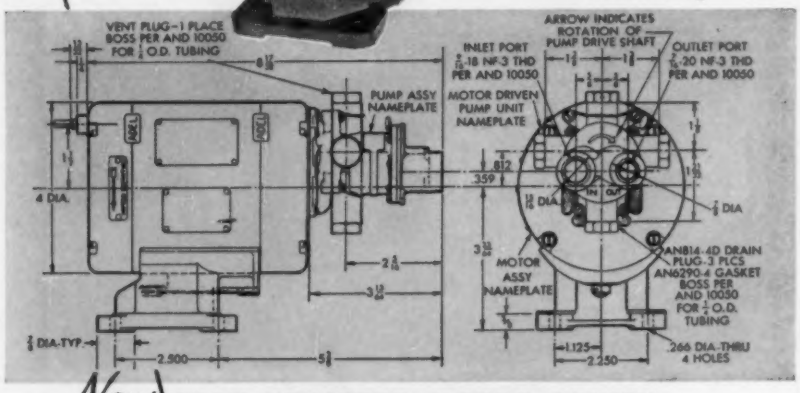
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CANADIAN REPRESENTATIVE: RAILWAY & POWER ENGINEERING CORPORATION, LIMITED

Air Transport Is Israel's Lifeline

(McGraw-Hill World News)

Tel Aviv—Air communications are vital to Israel. Still technically at war with her Arab neighbors, Israel has no external land transport connection. And the sea lanes to her friends are long.

Thus, El Al, the government-sponsored airline, is Israel's major traffic link with the rest of the world. In the six years of its existence, El Al has achieved, in the opinion of many foreign experts, "good progress" and displayed a high degree of initiative and dynamism. The fact that the Israelis are very air-minded has helped give the carrier a mighty boost. In 1954, El Al carried 32,000 passengers, against 40,000 for Zim, the steamship navigation company.

▶**Busy Schedule**—El Al now links Lydda Airport with New York (three weekly flights), London (four flights), Paris (four), Johannesburg (one), Rome (four), Istanbul-London (one), and Istanbul-Paris (one). In addition, planes leave for Vienna, Athens and Nicosia (Cyprus) on frequent schedules. Freighters fly to all of these places, as well as Amsterdam.

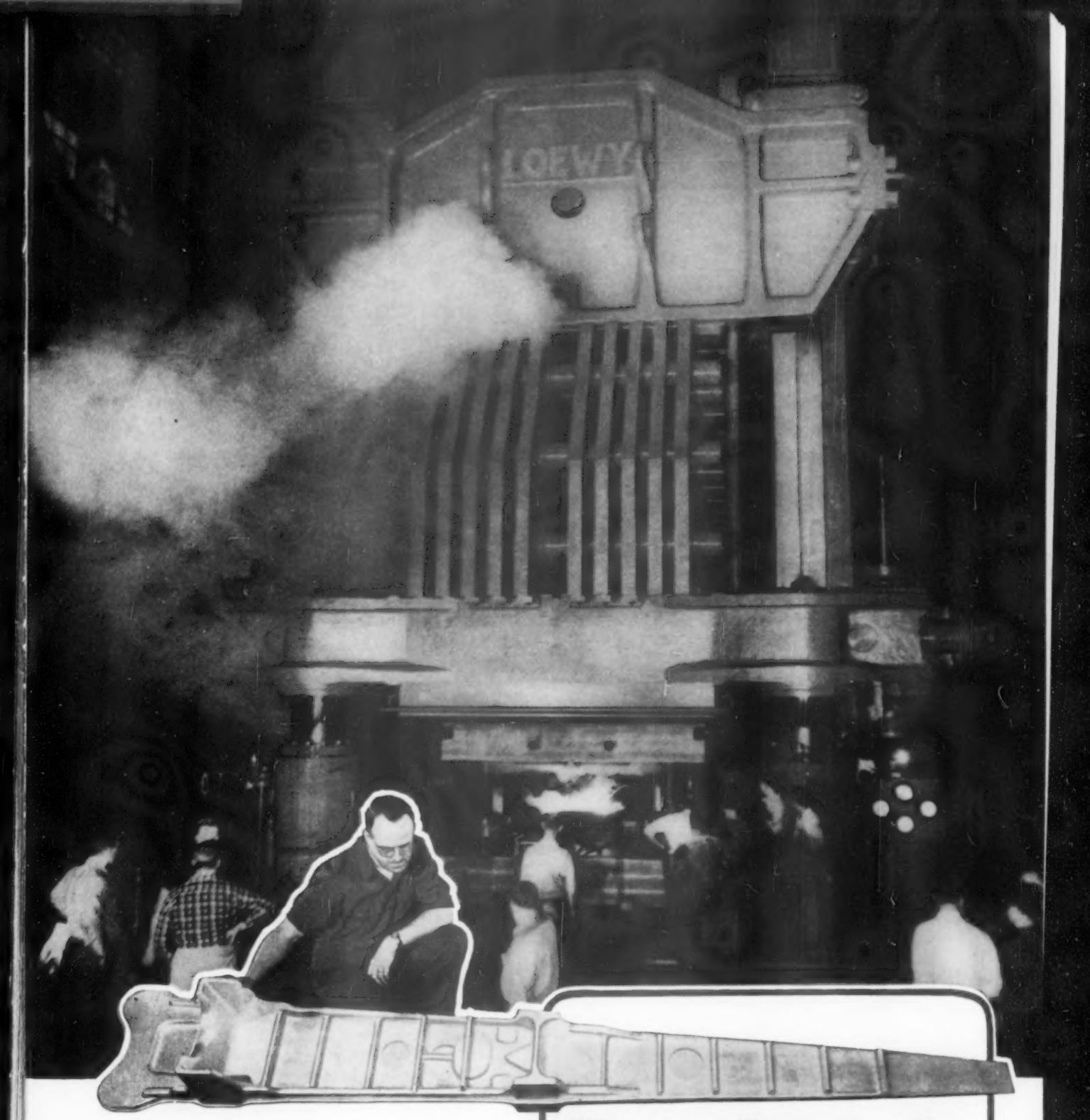
From Duesseldorf (Germany), they bring restitution goods once a week, under the Agreement on Reparations between Israel and West Germany. The company has no direct links with Iron Curtain countries.

El Al's 32,000 passengers in 1954 included 6,100 international travelers flying between points outside Israel. The corresponding figures for 1953 were 29,000 and 4,600. Traffic for previous years: 1952—23,000; 1951—19,200; 1950—14,700.

These figures do not include immigrants, whose number is large. Immigrants are carried on both El Al and chartered planes. Out of 1,120 flights in 1954, about 950 were regular and 175 were immigrant operations. Passengers include local officials, businessmen, immigrants and tourists, members of Zionist groups, and Christian pilgrims to the Holy Land.

El Al says it handles 50% of Israel's total air business—43% of the passenger traffic, 65% of the freight and 40% of the mail. To cover its network, the airline uses a fleet of four Lockheed 049 Constellations and four Curtiss C-46 Commandos (two of which are freighters). Utilization is said to be as high as 65%. An Airspeed Consul serves for training purposes.

▶**For the Future**—El Al recently ordered three Mark 300 Britannias for its long-range routes. The purchase apparently is being financed by the government. Just how the government



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will arrange the financing is not specified, but previously loans have been secured from the Chase National Bank, now Chase Manhattan Bank and were repaid out of El Al's profits.

A big training department operates in cooperation with ICAO and trains pilots, navigators, flight engineers, radio operators, dispatchers and ground mechanics for licenses. El Al's captains are still mainly foreign nationals, but they will gradually be replaced with Israelis.

To foster internal air communications, the government has established the Arkia Co., in which El Al has a 50% interest. Arkia operates a small fleet of Commandos and de Havilland Rapides, and runs daily flights between Lydda and Eilath (on the Red Sea), and other points in the country.

The Chim Avir Co. operates a fleet of small planes used for agricultural spraying and dusting. The aircraft are now based in Haifa and service agricultural settlements in many parts of the country.

El Al sends its engines for overhaul to the BOAC base in Britain. However, last year Bedek organized a large and uptodate repair base, scheduled to play an important part in local aviation activities. Bedek, a government-controlled venture run by Americans and American-trained Israelis, is reported to represent an investment of $2 million in foreign currency and $1 million in local currency.

In addition to handling conventional types of aircraft, Bedek has reportedly acquired equipment for the handling of jets.

Likely developments in 1955 include additional technical, operation and building improvements at Lydda, to facilitate international traffic; at Haifa, which serves mainly as a base for internal and Nicosia flights; at Eilath and some private companies' air fields.

► **More Tourists Wanted**—El Al plans a promotion campaign in the U.S. to attract more tourists; a similar drive by Air France will concentrate on Jewish groups in New York. TWA will go after university students from coast to coast, church groups in the Midwest and the Pacific Coast, and various women's associations.

Only El Al and TWA run direct flights to and from the U.S.

If some form of peace is arranged between Israel and the Arab nations, this would enlarge the scope of the airline's operations in the whole area. Flights now ending at Lydda might be extended to other destinations.

Political developments in the Middle East or North Africa may originate new immigrant airborne operations, such as Israel has run in the past—Magic Carpet (the Yemenite airlift), Ali Baba (the Iraqi lift), etc.

Mexico Improves Terminal Facilities

(McGraw-Hill World News)

Mexico City—Mexican aviation recovered from the 40% devaluation of the Mexican currency in April of last year after the government granted general fare increases of 20%.

Mexico's busiest single air route—the Aeronaves flight between Mexico City and Acapulco—carried a record number of passengers on the one-hour flight with its new fleet of Convairs.

The new $2-million airport in Acapulco, located on the opposite side of the city from the former field, was placed in service in December and provides more rapid handling of passengers as well as greater comfort through its handsome new waiting rooms, restaurants, ticket and baggage offices, etc.

At the same time, Aeronaves in January inaugurated its first direct flight between the U. S. and the famed Acapulco resort. The flights will be nonstop from Tijuana on the U. S. border directly to the Acapulco airport. Previously passengers from California have had to go by way of Mexico City, which usually meant on overnight stop in Mexico City.

Compania Mexicana de Aviacion, Mexico's largest domestic carrier, flies its domestic routes to nearly all parts of the country. It has added several new runs.

CMA, an affiliate of Pan American, is reported to have ordered three DC-7s —the first of this type to be ordered by a Mexican airline. It is said here that these planes are to be used on a new CMA route nonstop to New York City, from the Mexican capital. Confirmation of this has not yet been forthcoming.

The new Mexico City central airport, which went into service in the early part of last year, has proven unusually successful, and its operation has been widely applauded. The handsome $4.5-million structure, one of the largest in the world, can handle up to 24 DC-6s at a time and is capable of handling 17,000 passengers a day.

The arrangement for international passengers in the new airport has been particularly successful. It follows an unusually good traffic pattern which permits visitors to see passengers alight from the plane, speak to them across a fenced-off garden area and then follow their entire course through immigration and customs by watching the passengers through plate glass windows from a central waiting room.

In effect, the incoming passengers go in a U-shaped course around the waiting room which has plate glass on all sides.

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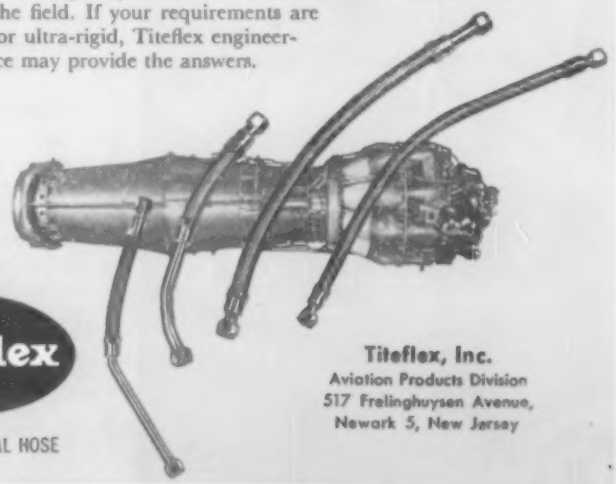

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AVIATION CALENDAR

Apr. 18-21—Society of Automotive Engineers. Golden Anniversary Aeronuatic Meeting, Aeronautic Production Forum and Aircraft Engineering Display, Hotel Statler and McAlpin Hotel, New York.

Apr. 18-21—American Society of Mechanical Engineers, Diamond Jubilee spring meeting, including four aviation sessions, Lord Baltimore Hotel, Baltimore.

Apr. 20-22—American Rocket Society, spring meeting, Baltimore.

Apr. 24-28—Airport Operators Council, eighth annual meeting, Seattle.

April 25-May 6—International Air Transport Assn., eighth technical conference, San Juan, P. R.

Apr. 27—Pratt & Whitney Aircraft, first 1955 forum on engine operation and maintenance, East Hartford, Conn. Other forums: Seattle, May 13; Oakland, May 17; Burbank, May 19; St. Paul, May 24; Millville, N. J., Sept. 14; Miami, Sept. 19; Dallas, Sept. 21.

Apr. 27-29—Society for Experimental Stress Analysis, spring meeting, Hotel Statler, Los Angeles.

Apr. 27-30—American Helicopter Society, 11th annual forum, Hotel Mayflower, Washington, D. C.

Apr. 28-29—Michigan Aeronautical Conference, University of Michigan, Ann Arbor.

Apr. 29—Institute of Navigation, eastern regional meeting, Friendship Airport, Baltimore.

Apr. 29-30—New England radio-electronics meeting, sponsored by Boston and Connecticut Valley sections of IRE, Sheraton Plaza Hotel, Boston.

Apr. 30—Air Force Assn., Illinois Wing convention, Sheraton Hotel, Chicago.

May 2-5—Society of Aeronautical Weight Engineers, national conference, Hilton Hotel, Ft. Worth.

May 3-5—Instrument Society of America, first national Flight Test Instrumentation Symposium, Allis Hotel, Wichita.

May 4-6—Fourth International Aviation Trade Show, 69th Regiment Armory, New York.

May 5—First International Aircraft Mart Exposition, Will Rogers Memorial Coliseum, Ft. Worth.

May 5-7—National Inter-Collegiate Flying Assn., annual convention and air meet, Meacham Field, Ft. Worth.

May 7-8—Association of Northeastern College Flying Clubs, annual inter-collegiate air meet, Troy (N. Y.) Municipal Airport.

May 9-11—National Conference on Aeronautical Electronics, Biltmore Hotel, Dayton.

May 16—National Fire Protection Assn., annual aviation seminar, Netherland Plaza Hotel, Cincinnati.

May 16-20—National Materials Handling Exposition, produced by Clapp & Poliak, International Amphitheatre, Chicago.

May 18-20—National Telemetring Conference, Morrison Hotel, Chicago.

May 23-24—American Society for Quality Control, ninth annual convention, Hotels Statler and New Yorker, New York.

May 30—Federation Aeronautique Internationale and KNVvL Royal Netherlands Aeroclub, fifth International Air Display, Ypenburg Aerodrome, The Hague.

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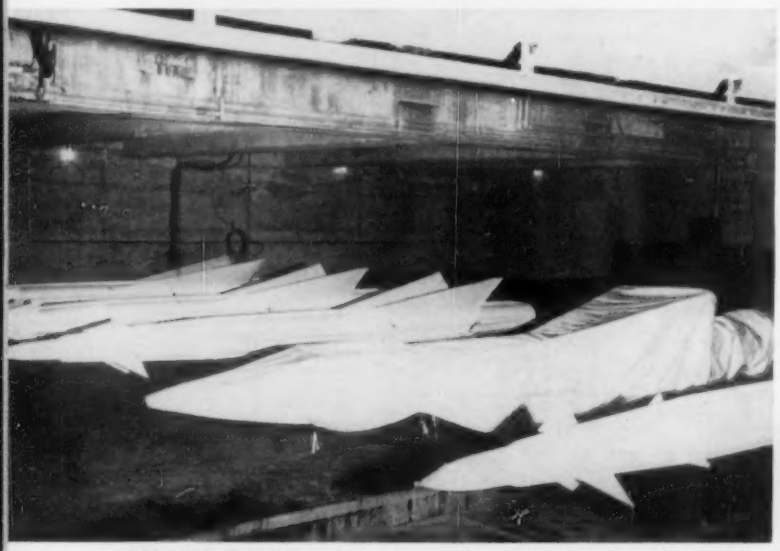
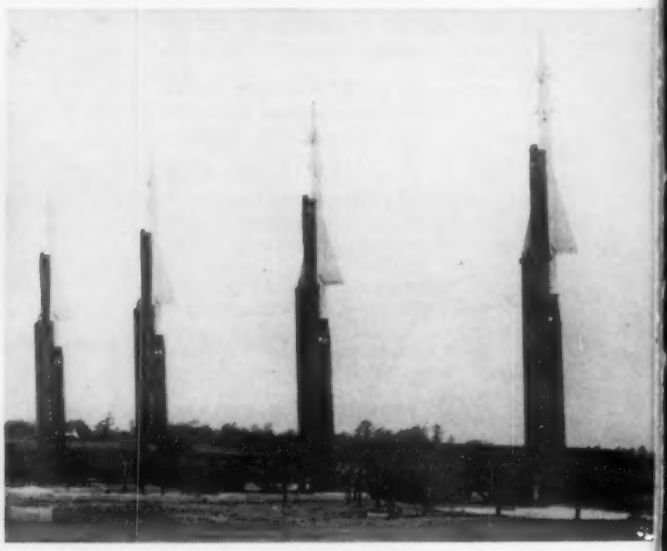
IN THE HEART OF THE DELAWARE VALLEY

NIKE ON RANGE at Army's White Sands Proving Ground shows some of the launching and handling equipment taken into the field.





READY ALERT Nike missiles are stored as live rounds in underground magazine. Elevators lift birds to surface for firing.

How a Weapon System Operates in Field

By David A. Anderton

The Nike network, now assigned to the defense of 13 major American cities, furnishes an excellent example of field operations with one of the first weapon systems to be developed.

With nearly 100 Nike sites to be activated in the near future, the Army faces the multiple problems of constructing, equipping, supplying and justifying missile batteries stationed from New York to Los Angeles.

These problems are complicated by the continuing development of the system itself, which requires feeding improvements into each of the battery sites as fast as production lines turn them out.

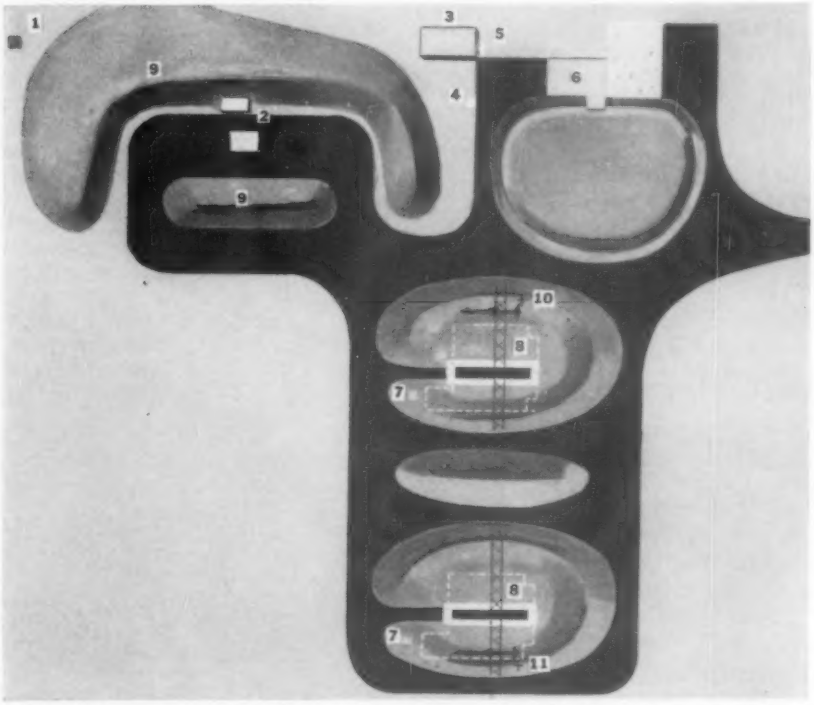
Army's initial decision was to treat Nike like any other piece of ordnance; to handle it with standard procedures from receipt to field use; to overhaul, maintain and update the system like any other item of field gear.

This decision—since modified only slightly—has paid off in the operational use of the first anti-aircraft missile system.

► **Background**—Nike is probably the oldest weapon system extant. It began as a postwar project under the control

How the Systems Concept Originated

NEW YORK DEFENSE is the responsibility of these proposed Nike batteries.



LAUNCHING SITE for Nikes shows: (1) acid storage; (2) acid fueling; (3) generator building; (4) JP-4 fuel pad; (5) transformer pad: (6) missile assembly and test building; (7) frequency changer pad; (8) underground missile storage; (9) earth blast mounds eight feet high; (10) and (11) launchers. This site is separated from the guidance area by about 1,000 yd.

of Bell Telephone Labs, and from the first was engineered along the systems concept long known to the communications industry.

Nike production responsibility is divided roughly half and half between Bell's manufacturing affiliate, Western Electric Co., and Douglas Aircraft Co.

Western Electric builds radars, command and control trailers and other gear; Douglas responsibility is for the missile airframe, launcher and control gear.

▶ **System Assembly**—The first time the components are married into a system is after delivery to the Army at its Ft. Bliss-White Sands Proving Ground area.

Meantime, the battery has been activated as a unit, and its personnel have been going through the training procedures and extra schooling required. The 100 officers and enlisted men are chosen off the top of the Army's lists. Many of the officers have engineering or scientific degrees. The enlisted men get nine extra months of schooling if they are to be electronics technicians, three months if they are to be mechanical or propulsion specialists.

These men work on the equipment that will be assigned to their battery. They assemble it, check it out, and get it ready for the field, under the watchful eyes of factory technicians and instructors.

▶ **Out to Launch**—The package unit of battery and men is formed. They make up a convoy and move out to the Tularosa basin, where a field battery is set up in the Red Canyon Range Camp area.

Under operational conditions, the battery fires its first rounds. They launch a few practice missions, then get a shot on a live run against a drone aircraft, generally a B-17.

After shooting down the drone, their practice sessions are over. The unit moves out of the range camp to a tactical site near a city.

▶ **Site Choice**—Selection of the area for the battery has been previously made, so that the unit can move right in and set up. Three basic considerations govern the site location: tactical layout, technical layout and logistics.

About 60 acres of land is needed for a single battery. Of this, about 30 acres is the buffer zone; this land can be worked by a farmer, for example, or can be used for domestic animals; it must not contain houses, nor places where crowds would naturally gather, like picnic areas.

Acquisition of the land is the biggest problem facing the local anti-aircraft commands. No community, even when its own future is at stake, delights in having a military unit move in. In addition, lack of a unified positive public relations program has hamstrung the Army in its attempts to convince the citizenry of Nike's values.

▶ **Site Layout**—A Nike site consists of two areas, each of about 15 acres, and located about 1,000 yd. apart. The guidance equipment and the administrative and housing facilities are together in one area. The other contains the underground magazine, fueling and arming stations and the launchers.

Biggest difference between the Nike battery in the field and at a fixed site is the underground magazine. Here in a concrete storage vault about 58 x 62 x 12 ft. are stored the ready missiles.

Other equipment at the launching and guidance sites is the same as that used in the field, with the exception of the semi-permanent types of housing.

The entire field system is air-transportable, so that the working units of a battery can be airlifted to defend special areas or for mobility from one theater to another. For this reason, magnesium has been used to a maximum; the trailer vans are built largely of a magnesium-

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How the Systems Concept Originated

Credit for originating the systems concept could be assigned to the Bell Telephone Co., which coined the name "Bell System" during the latter part of the 19th century.

Said a Bell spokesman, "If we hadn't worked along the lines of the systems concept, you still wouldn't have telephone service."

Application of the systems idea to a weapon came about after Bell's experience during World War II. The firm was responsible for only a piece of Army's anti-aircraft fire control systems, and continually heard complaints from the field about mismatched units, of which their work was only a part.

After the war, when Army asked Bell to investigate a missile system, the firm suggested as strongly as possible that it be done according to the workable ideas of a systems concept. Army agreed, and Nike was the result. After a preliminary design study of five-months' duration, Douglas Aircraft was called in as an equal partner.

paper honeycomb for lightness.

▶ **Tactical Operations**—A tactical battery unit receives Nike missiles in special shipping containers from the factory. They are delivered to an assembly and test building where the warhead, booster and launching rail are attached.

After checkout of the mechanical and avionic gear, Nike is moved to fueling stations and filled. It is now a live round, ready for immediate action.

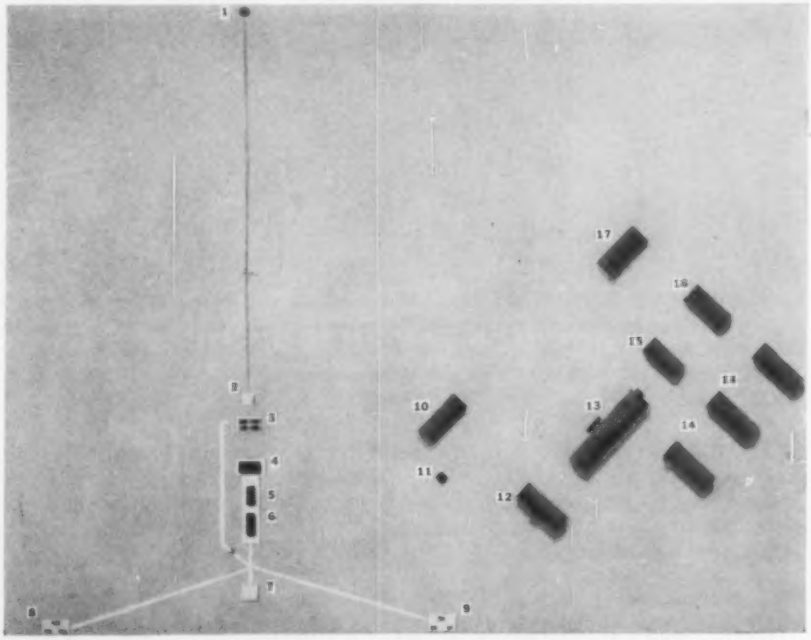
In this condition, it is taken to the underground magazine and stored in a ready alert condition. Periodic checks of avionics equipment and inspections of mechanical parts will continue during the stored life of the missile.

For firing, the missiles are moved from the underground magazine onto an elevator in the center of the vault. On the surface, the Nikes are manhandled across the launcher ready racks on either side of the elevator shaft. During firings, the elevator seals its shaft to prevent any blowby down into the magazine.

▶ **Training**—During the time a tactical unit is on a fixed site, there is continual training of the battery, with special emphasis on radar tracking. Commercial planes are tracked for practice.

In addition, alerts are fed into defense areas and Nike batteries go into action, stopping short of firing a live round. They are simulated dry runs with dummy rounds that never get off the ground, to maintain proficiency in launching and handling techniques. But the battery never knows until the last second whether or not an alert is a practice session or the real thing.

Once each year, the battery moves from its tactical site back to the Tularosa basin in New Mexico to fire another live round against a target drone.



CONTROL AREA for Nike: (1) bore-sighting mast; (2) transformer pad; (3) frequency changers and generators; (4) spare parts van; (5) radar control trailer; (6) battery control trailer; (7) acquisition radar; (8) missile tracking radar; (9) target tracking radar; (10) supply bldg.; (11) fuel oil storage; (12) administration bldg.; (13) mess hall; (14) barracks; (15) latrine; (16) BOQ; (17) motor shops.

On the New Republic F-84F, Aeroquip Self-Sealing Couplings

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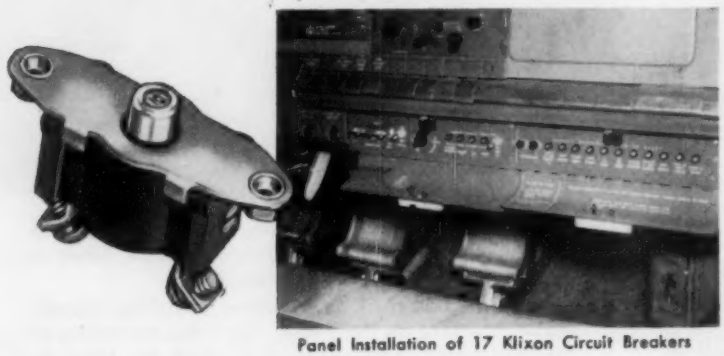

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other live round against a target drone. As in their early training, they work under field conditions.

▶**The Mission**—Nike sites are located for close-in defense of cities. The assumption is that the majority of the enemy bomber fleet will be knocked out at some distance from the target by interceptor aircraft, and that Nike will have only the last remnants of the attack to shoot down. In this respect, Nike performs the same function as anti-aircraft artillery.

An early-warning alert is routed to batteries in a target area during an enemy attack. The alert specifies the direction of attack, among other data. Nike radars go into action, working the attack sector to pick up the bomber fleet coming in. The acquisition radars lock on to the selected target within the fleet, while other radars keep tracking the rest of the attacking force.

At the first alert, battery personnel get the missiles ready for the attack, and perform final functional checks of equipment.

All safety locks and controls are removed; the live missiles are rolled out along the ready racks and others are prepared in the magazine to replace the fired Nikes.

The incoming attack crosses the distant deadline, and the battery commander gives the firing orders. Nike roars off the launcher, reaching supersonic speed before booster dropoff. At separation, the booster tumbles to impact in the buffer zone and Nike hurtles upward to destruction.

▶**Systems in Use**—These descriptions apply only to the Army's Nike anti-aircraft missile, but they are typical of the kind of operations that a missile system would undergo between the formation of units and tactical operations.

Other systems in the field include the Army's Corporal rocket, manufactured by Firestone and Gilfillan Brothers, and USAF's Matador, built and developed by the Glenn L. Martin Co.

First fruits of the aircraft systems concepts have yet to get into military use, although the three missile systems named above will shortly be joined by others.

But as in the case of design, development and production, the operational use of a weapons system forces a different approach to an old problem—the efficient use of a military machine.

Engineers Form Die-Casting Society

A new technical group has been formed to develop modern standards for the die-casting industry and exchange, accumulate and disseminate data.

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Necessity created the Pesco DC and high frequency AC Electric Motors. Because Pesco could not get motors to meet its strict requirements, you can now buy better motors for your special applications.

Pesco engineered and developed this line of 1/100 to 11 horsepower motors to answer the need for completely dependable operation under critical conditions. Pesco Electric Motors assure optimum performance and efficiency throughout a long service life. They combine maximum power with minimum size and weight, yet withstand rugged environmental extremes. These motors are now available to you.

Both DC and AC types are made in five "coordinated frame" sizes which permits use of standardized parts having known characteristics. This expedites design and speeds delivery of motors built to your exact requirements.

Pesco high quality motors have many features not found in ordinary motors . . . such as dynamically balanced rotors, high strength alloy shafts, extremely tight windings, advanced-design brush rigging, multiple impregnations, brush material selected for specific use, high capacity sealed ball bearings and special insulations. If you are looking for a good source for special purpose electric motors, look to Pesco.

To learn more about Pesco Motors for industrial or aircraft uses, call in a Pesco sales engineer . . . or send for a brand new technical bulletin. Write: PESCO, 24700 North Miles Road, Bedford, Ohio.

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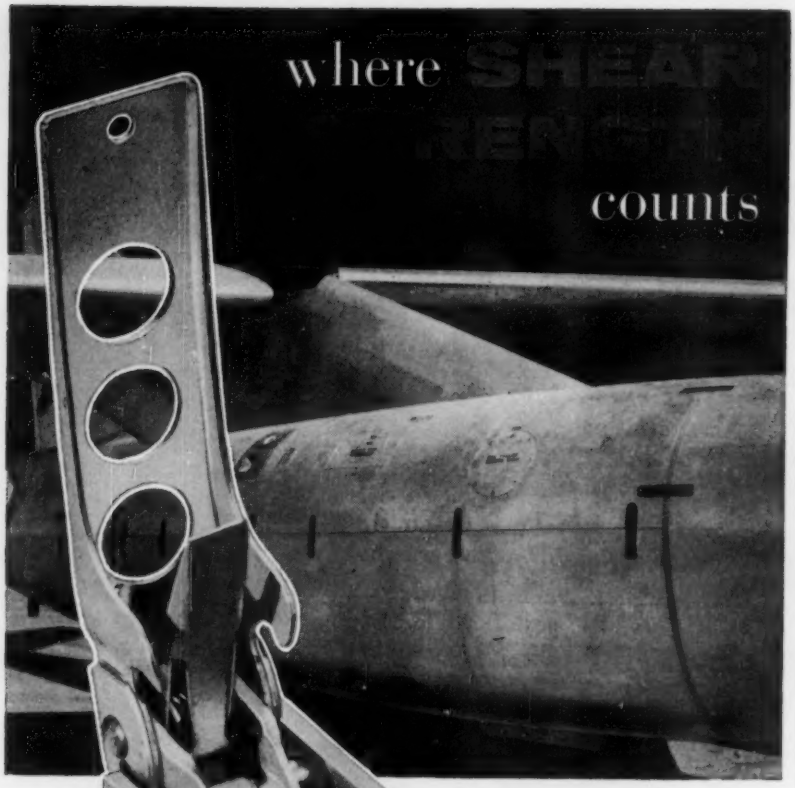

DOUGLAS RB66
MEDIUM BOMBER

High shear and tension strength, positive engagement of latch components and quick, easy operation, even under loads, are some of the characteristics "designed-into" Camloc Heavy Duty Latches. They are built to withstand the toughest aircraft service ...securing engine cowlings, cargo doors, access panels and other removable parts. Technical data about latch design and performance is available on request.

Heavy Duty Camloc Latches are used to secure engine cowlings on the Douglas RB66 Medium Bomber.

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Casting Engineers is open to personnel engaged in die casting, molding, finishing and related work. National headquarters and offices will be located at 19370 James Couzens Highway, Detroit 35, Mich. President is Harris Shimel, Chevrolet-Bay City Division of General Motors.

Rocket Propellants Subject of New Study

Combustion control of solid-propellant rockets will be one of the objects of a new research program at Princeton University's Forrestal Research Center under sponsorship of the Aerojet-General Corp.

New solid propellants of the composite type—using a plastic binder-fuel and a granulated oxidizer—have made it posible for engineers to design a special propellant combination for each category of rocket powerplant.

But the engineer must be able to calculate the burning properties of the propellant from its chemical formula. This is only possible with very complete data on the basic physical properties of combustion.

Aerojet's grant has no strings attached; there are no limitations on the research program imposed by the company.

The results are to be published in scientific journals and made available to rocket engineers and designers with an interest in the subject.

The solid-propellant burning program is led by Prof. Martin Summerfield, assisted by graduate students George S. Sutherland and Dwight A. Mahaffey.

THRUST & DRAG

"If the record of our experience is to serve us well, we need to be able to extract from it at will, promptly and inexpensively, any single item of current moment. . . .

"We are building the record at a prodigious rate. . . . The Library of Congress reported in its Quarterly Journal of Current Acquisitions for August 1954 that in fields of science, technology, medicine, and agriculture it received approximately 30,000 journals including 2000 new titles; 25,000 research reports; 15,000 books and monographs; 15,000 manuscripts; 10,000 pamphlets; 5,000 prints, blueprints, microfilms, etc.; and 150,000 maps and charts.

"Our libraries are filled to overflowing. and their growth is expotential Yet in this vast and ever-increasing store of information we still hunt for particular items by horse-and-buggy methods. As

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AC WELDERS
Sizes up to 625 amps. All connectable to 220 or 440 volts—550 volts on request.

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Capacities from 2500 to 36,000 lbs. — remote-control and hand-operated models.

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The first machine to give you either AC or DC current at the flip of a switch.

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Four sizes—200, 300, 400, and 500 amps.

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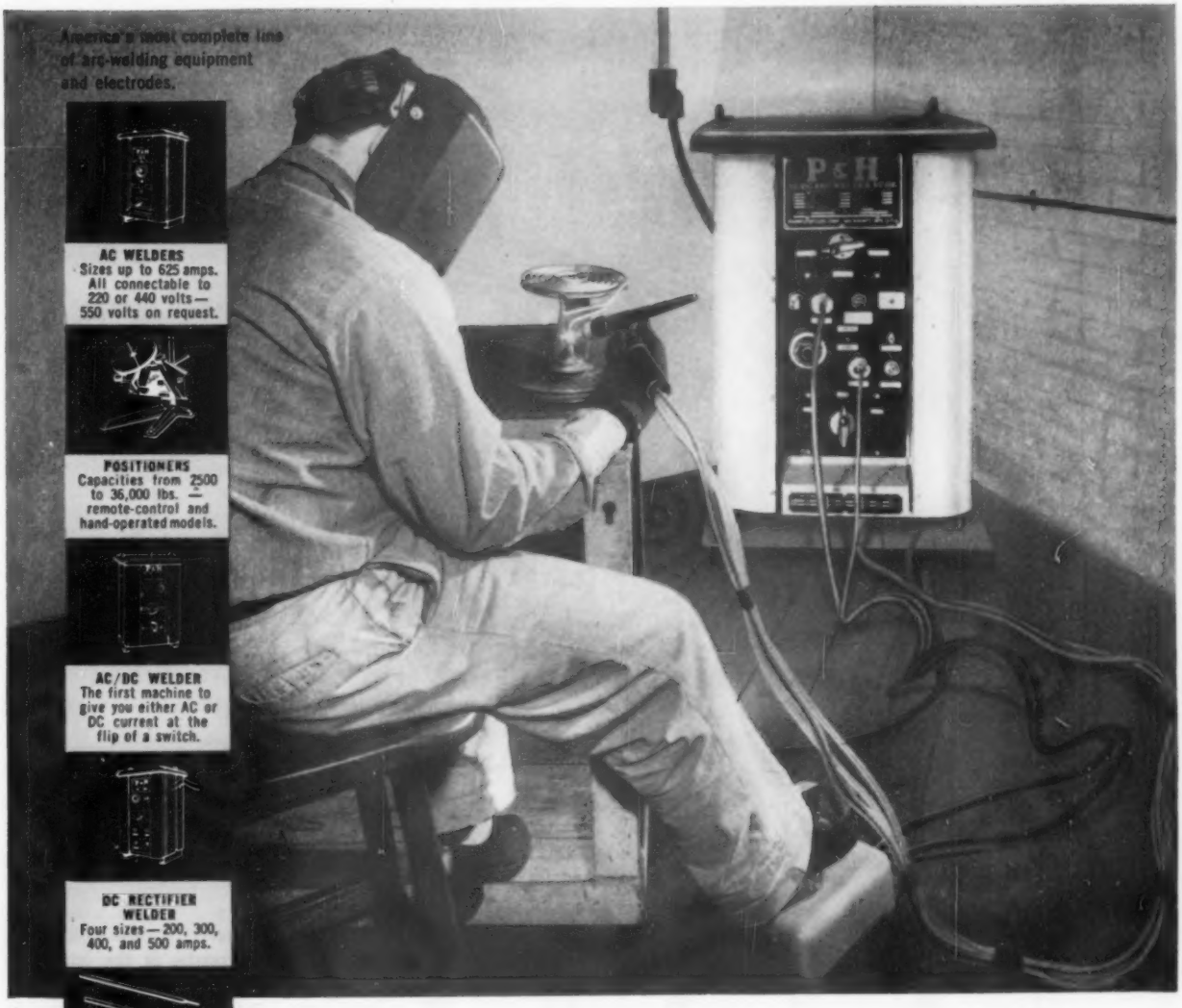
For mild steel, cast iron, "hard-to-weld" steels, stainless steels, hard surfacing.



Just think - 7 welders in 1

. . . save money on every job with this versatile AC/DC P&H Welder

"This new AC/DC P&H Welder beats anything we have ever used." That's what Lawrence Beggs of the Research Weld Co., Racine, Wisconsin, says.

"Ours is mostly precision work," Mr. Beggs continues, "involving Heliarc* welding of stainless, aluminum, and magnesium. We can switch from DC for welding stainless to AC for aluminum or magnesium, as easily as turning on a light. With its automatic high-frequency and instant response to control, this machine is wonderfully easy to use. We have had new men make acceptable welds with it after just a few minutes' instruction."

And you can't beat this new AC/DC machine for flexibility. You can use it for metallic arc welding, either AC or DC, straight or reverse. It can be used with Automatic Heliarc* AC or DC welding, or the Sigma Welding Process. It can even be adapted for use as an AC or DC Spot Welder.

Two models (200 and 300 amps) give you the range of capacity you need. Call your nearby P&H representative or distributor for an eye-opening demonstration of this remarkable new welder or write us for complete details — now. Welding Division, Harnischfeger Corporation, 4480 W. National Ave., Milwaukee 46, Wisconsin.

*T. M. Linde Air Products Co.

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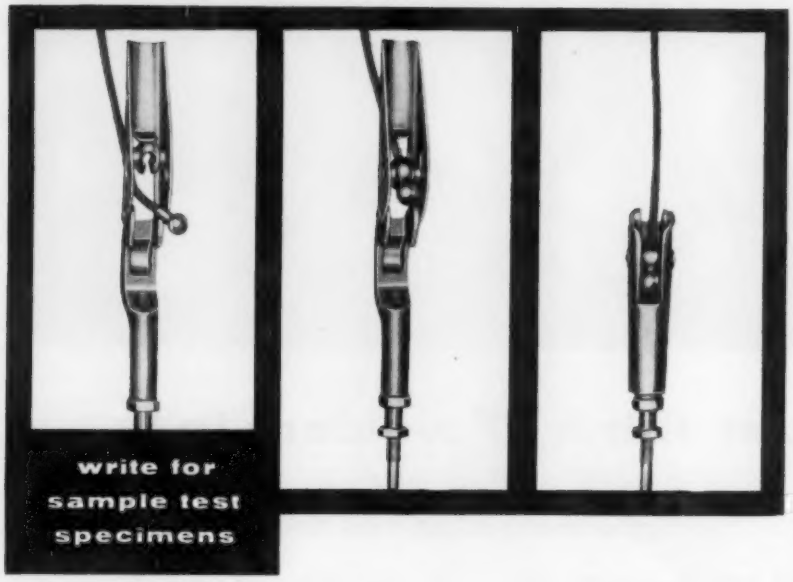
the P&H Line

P&H welding equipment is manufactured and sold in Canada by REGENT EQUIPMENT MANUFACTURING COMPANY LTD., 455 King Street West • Toronto, Ontario, Canada

North American F100 uses Bohanan Quick Disconnects in all cable control systems.

BOHANAN
quick disconnect



write for sample test specimens

Bohanan Quick Cable Disconnect provides:

1. instant disconnect for cable in tension;
2. instant reconnection *without* resetting cable tension

STOCK SIZES:

1/16″ - 3/32″ - 1/8″ - 5/32″ with 3″ adjustment.

note—stressed to 140% of cable strength.

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Engineers looking for a future, submit resumé.

a result there is much duplication and repetition of research. We are being smothered in our own product.

"While we record with great care the work of thousands of able and devoted men, full of significance and timeliness to others, a large and increasing fraction of their work is, for all essential purposes, lost simply because we do not know how to find a pertinent item of information after it has become embedded in the mass.

"The problem is not essentially one of techniques. It is rather one of deciding who is to do the job of clearing up the confusion and under what auspices. There are plenty of good techniques available. . . .

"But to code our scientific literature or our legal documents or any other part of our mounting records and thus to place them under the control of machinery responsive to our will is a stupendous undertaking. . . . It would pay everyone, and the expense should therefore be borne by everyone. Thus it is a task for government. But is it possible for a government which cannot even mechanize its postal system to be farsighted and courageous enough to undertake a task of such complexity and such magnitude? Probably not."

—From an address by Vannevar Bush, president of Carnegie Institute of Washington, before the American Society of Mechanical Engineers.

* * *

The serious and comic aspects of space flight received a thorough treatment on TV recently at the hands of Walt Disney's outstanding crew. The boys from Uncle Walt's Mouse House really outdid themselves in graphic, animated presentations of the possibilities and problems of that first flight into space.

Highlights of the hour-long program —for two small boys who are related to me—was the final episode: a magnificently done interpretation of the first flight. All three of us sweated through the countdown, agonized through main stage and each successive stage firing; we were awed at the sudden silence when the motors shut off and we started drifting in the blackness. We hated to reverse thrust and start the long fall toward earth.

The drama of the last few moments was as great as that of the first few. The spell of background music and the vast panorama of earth spreading below worked its magic, and we three watched the delta-winged top-stage glide down through clouds to the concrete strip. We watched that bit through misty eyes, all three of us.

They wanted so badly to grow up quickly, so that they could go. And I had grown up too quickly, and already am too old.—DAA

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How to insure valuable equipment against damage

In the test illustrated above, a Koch Fiberglas carrying case was loaded with three times its weight and dropped 250 feet into the sea. The case was undamaged.

This remarkable case, made only by Koch, is revolutionizing the whole concept of protecting valuable equipment of all kinds in shipping, handling and long term storage.

The case will not dent. It will not corrode, so painting is unnecessary. It safeguards against shock, vibration, fungus, mildew. No outer crating or other protection is required for shipment or storage. The Koch Fiberglas case is absolutely airtight, and under severe tests has maintained a vapor and moisture transmission rate of zero.

Cushioning material inside the case is moulded to fit perfectly the contours of the equipment, giving maximum protection against vibration and shock.

Sixty thousand Koch Fiberglas cases are now in service with the U. S. Air Force and BuAer all over the world. To date there has not been a single unsatisfactory report, or casualty to a case or the valuable equipment it contains.

If you manufacture equipment that needs this kind of protection, we will be glad to confer with you about your problem. Address Dept. AM.

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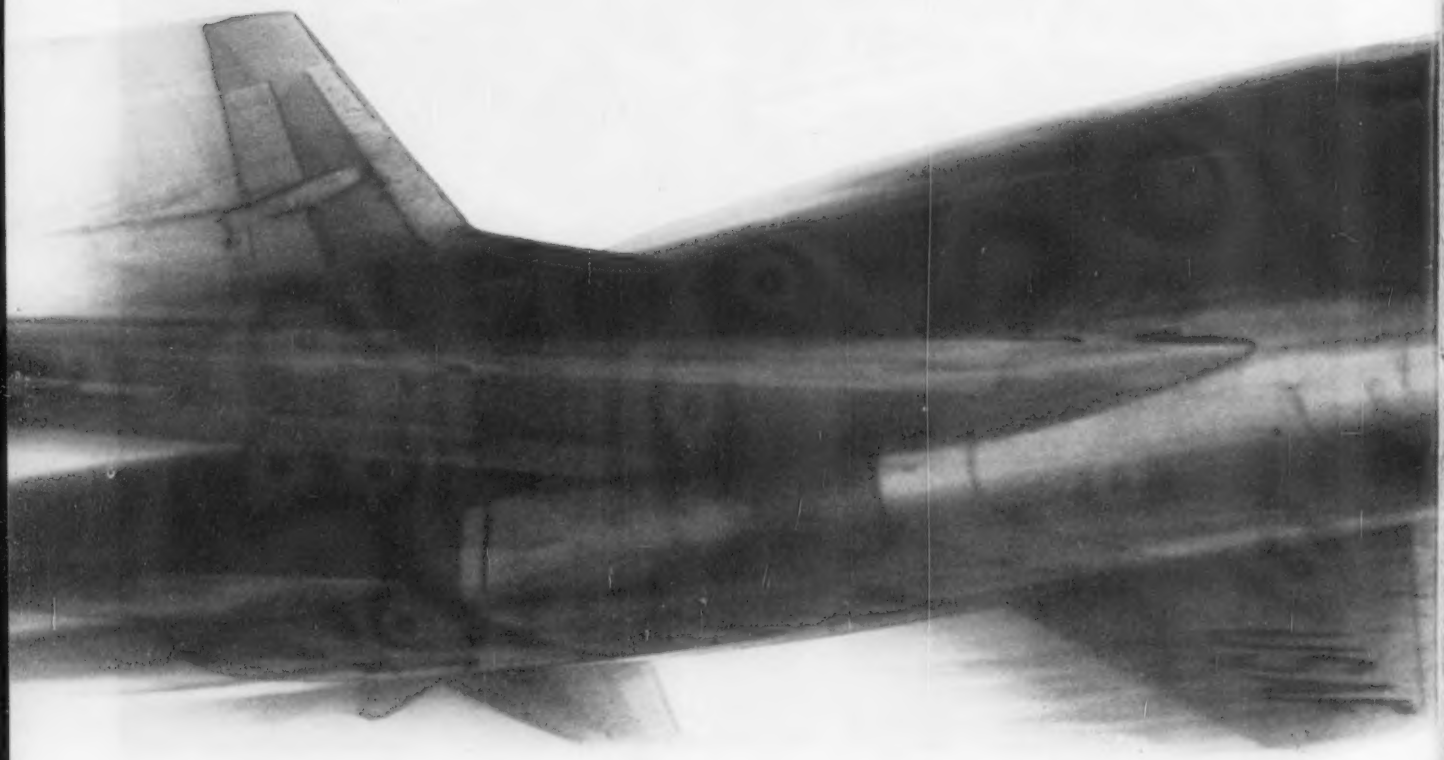
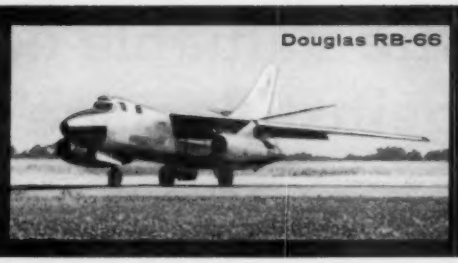
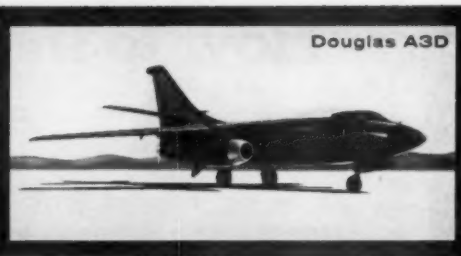


Boeing B-52

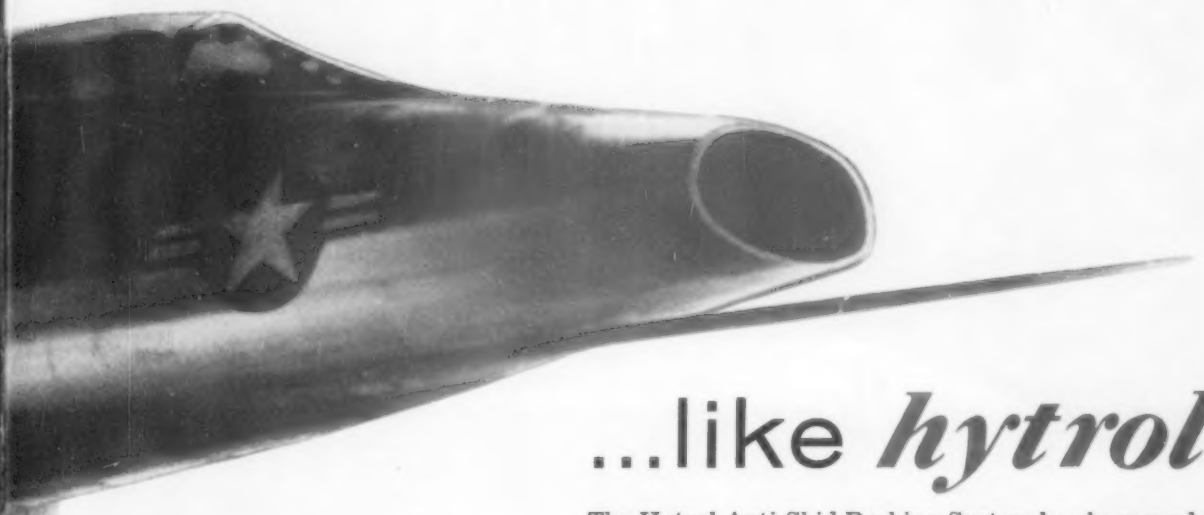

Douglas RB-66


Douglas A3D

Illustrated are some of the most advanced combat aircraft now going into service with the U. S. Air Force and Navy on which Hytrol is standard equipment. On other types, including commercial passenger planes like the Boeing Stratocruiser, Hytrol has been in continuous service for several years. Hytrol has proved equally dependable and effective on aircraft in the 15,000 lb. class and in the 300,000 lb. class.

Every airplane that needs a runway, needs *hytrol*.

the SUPER SABRE



...like *hytrol*®

The Hytrol Anti-Skid Braking System has been made standard equipment on yet another of the nation's latest military aircraft, the North American F-100. This news points up the fact that Hytrol is now established as a prerequisite for full efficiency with maximum economy and protection in modern flying operations.

Hytrol's acceptance is due to its proved economy in service as much as to the increased safety factor; for Hytrol pays for itself in tire and brake maintenance alone! The recognized advantages of Hytrol can thus be regarded as *net gains*.

ADVANTAGES PROVED IN SERVICE

- Runway mishaps due to swing, overshooting or late rejection of take-off absolutely minimized.
- Unforeseeable tire failure virtually eliminated.
- Bad runway conditions controlled. This includes rain, slush, snow, ice and within reason, uneven surface.
- Human error neutralized in landing technique.
- Utilization of aircraft increased by marked reduction in last minute repairs.
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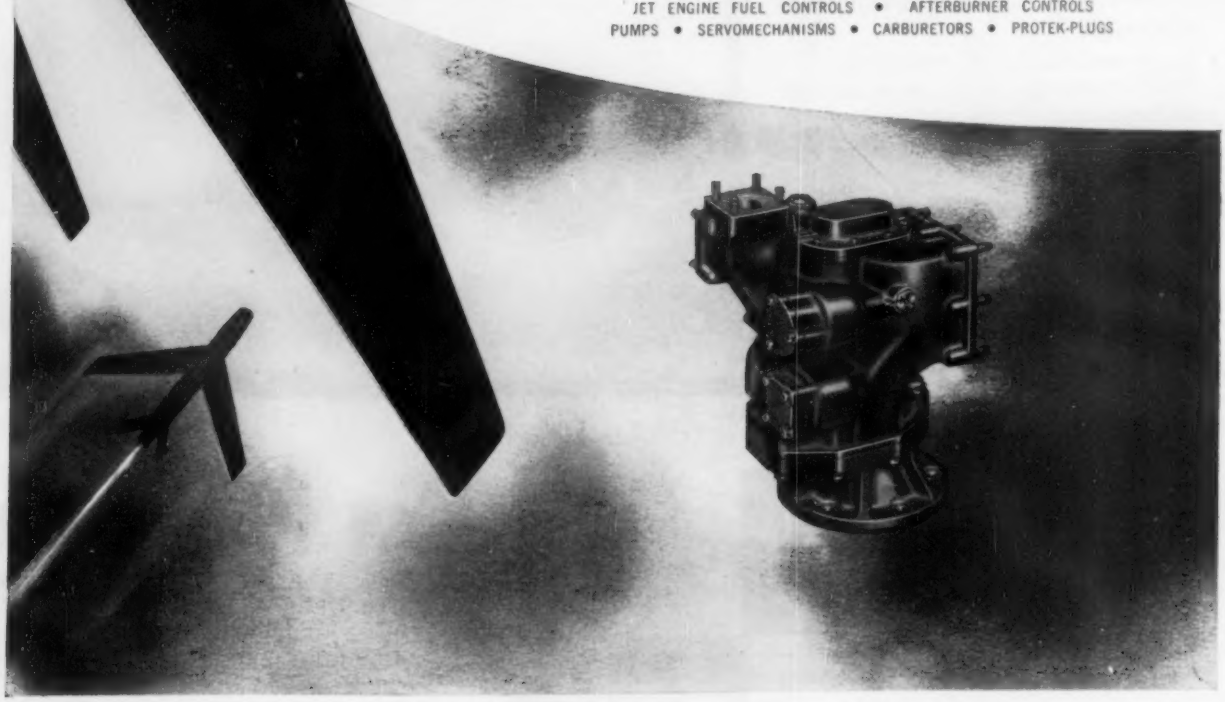
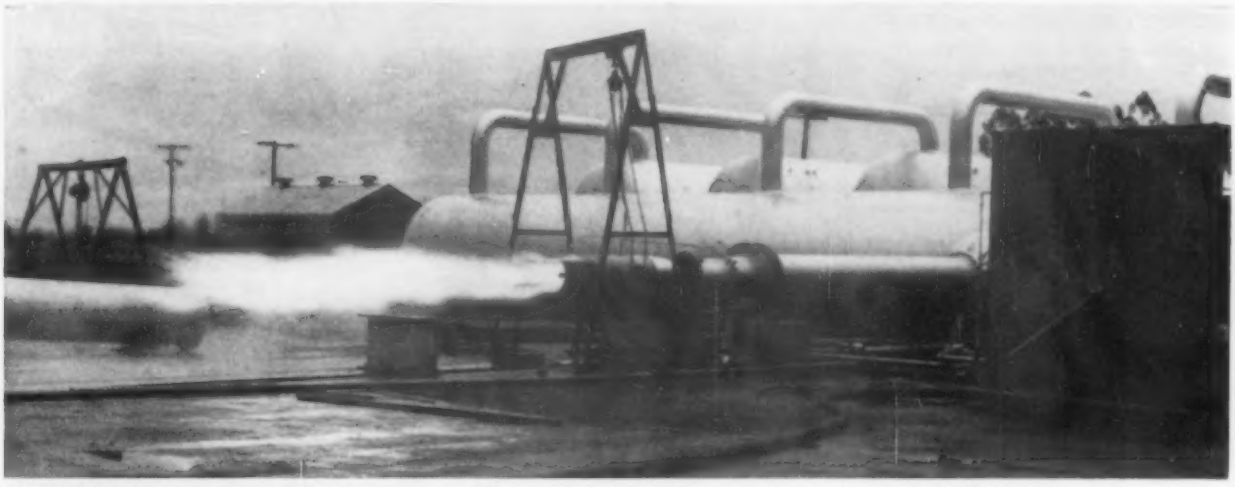
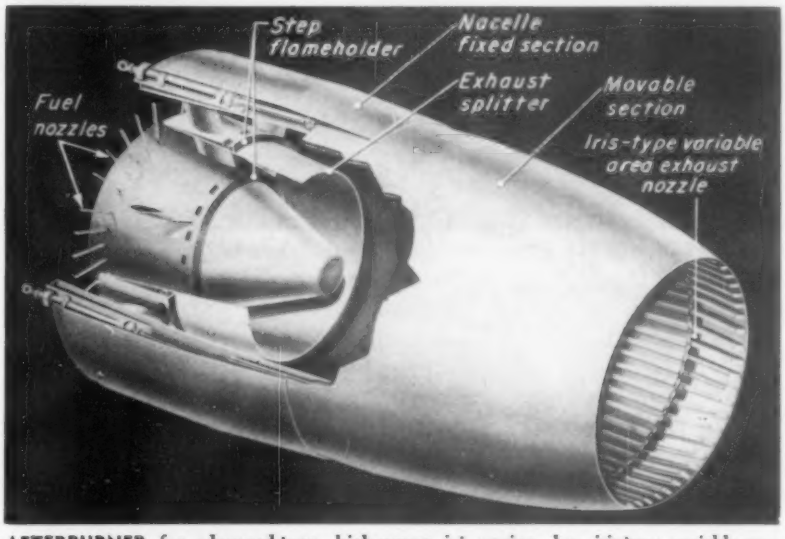




20-IN. RAMJET spews fiery exhaust during test in Marquardt's jet laboratory. Air storage tanks are behind test engine.



AFTERBURNER for advanced-type, high-power jet engine, has iris-type variable-area nozzle. Photo at right indicates size.

Marquardt Pushes Supersonic Projects

By Irving Stone

Van Nuys, Calif.—Marquardt Aircraft Co. has established itself firmly in the field of aircraft propulsion in just 10 years since its founding with a capital of $1,000.

While the bulk of Marquardt's efforts has been directed toward supersonic ramjet development for guided missiles, the company has also developed related engineering versatility covering afterburners, reverse thrust units, accessory drives, fuel controls and pumps, and emergency powerpacks.

Marquardt's engineering falls into three main categories—powerplants, accessories and tests. These three divisions are supplemented by a fourth division—long-range planning and research—which reports directly to Roy E. Marquardt, president.

The powerplant division works on subsonic and supersonic ramjets, afterburners and reverse thrust devices.

► **Subsonic Ramjets**—Supersonic ramjet development is getting the emphasis at Marquardt today, but subsonic ramjet work still continues.

In the subsonic field, Marquardt's powerplant engineers are developing ramjets as booster units for helicopter rotor tip applications. Basically, these engines are "two-dimensional" configurations designed so they fair into the blade tip, or are collapsed as part of the tip when not in use.

This work is being done under a contract for final development of the copter-tip installation for Wright Air Development Center. At this point, it has not yet been decided whether the faired or the collapsed (such as a parallelogram) configuration is most feasible.

Stretching out behind this subsonic ramjet work is a long list of subsonic engine developments. Among these is the C-20-.85F, a 20-in.-diameter ramjet which was used to power the Martin KDM-1 Plover, Navy target drone. About 600 were produced.

In 1951, this engine was flown for 15 min. in a KDM, an endurance time which has not yet been equalled in ramjet flight. Marquardt ramjets also hold records for speed and distance.

► **Supersonic Jobs**—Some of its super-

TRANSISTOR &
DIGITAL COMPUTER
TECHNIQUES

applied to the design, development and application of

AUTOMATIC RADAR DATA PROCESSING, TRANSMISSION AND CORRELATION IN LARGE GROUND NETWORKS

ENGINEERS
&
PHYSICISTS

Digital computers similar to the successful Hughes airborne fire control computers are being applied by the Ground Systems Department to the information processing and computing functions of large ground radar weapons control systems.

The application of digital and transistor techniques to the problems of large ground radar networks has created new positions at all levels in the Ground Systems Department. Engineers and physicists with experience in the fields listed, or with exceptional ability, are invited to consider joining us.

FIELDS INCLUDE

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DIGITAL COMPUTING NETS
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VERY HIGH POWER MODULATORS
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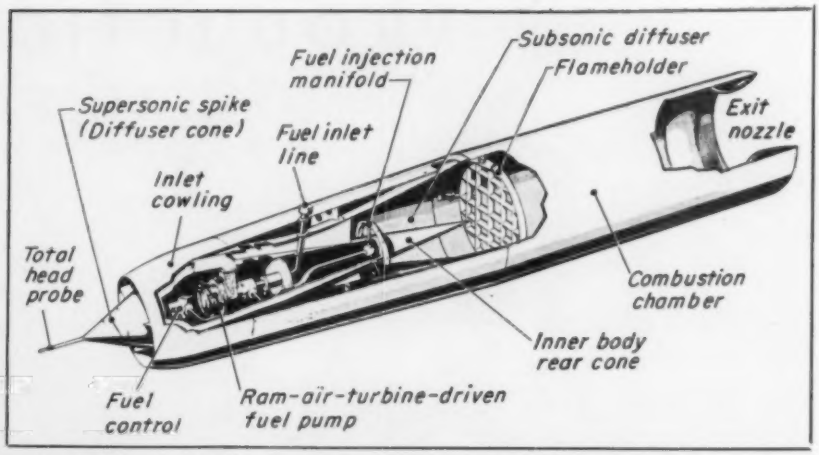
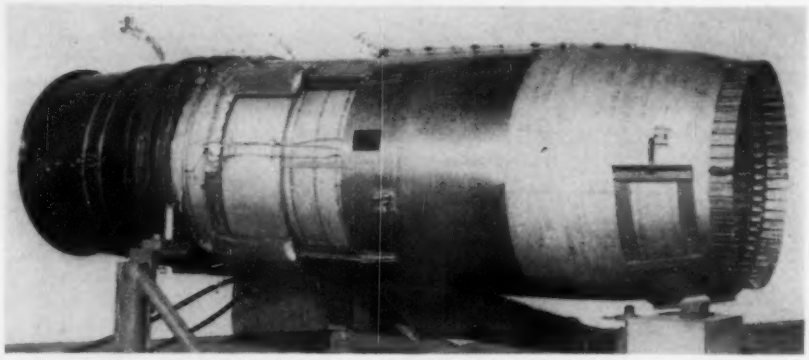
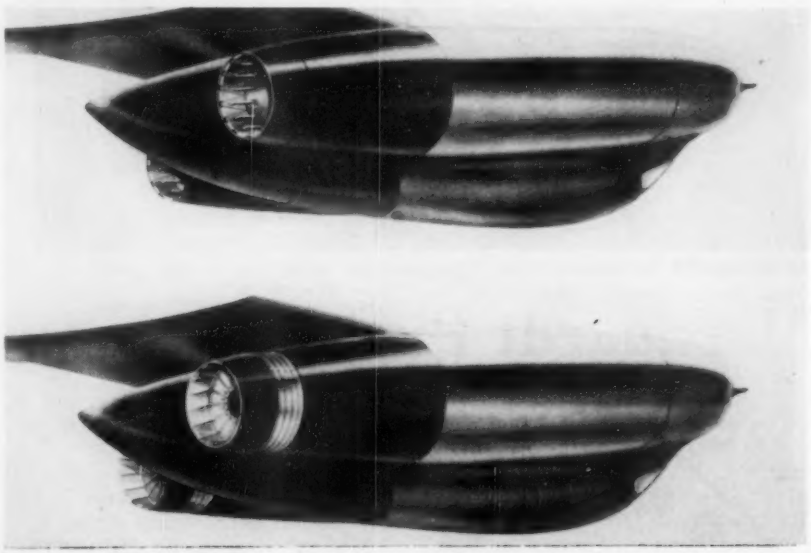


SUPERSONIC RAMJET development at Marquardt is typified by this engine cutaway.



VARIABLE-AREA NOZZLE is fully open (right) in this photo of Marquardt afterburner.



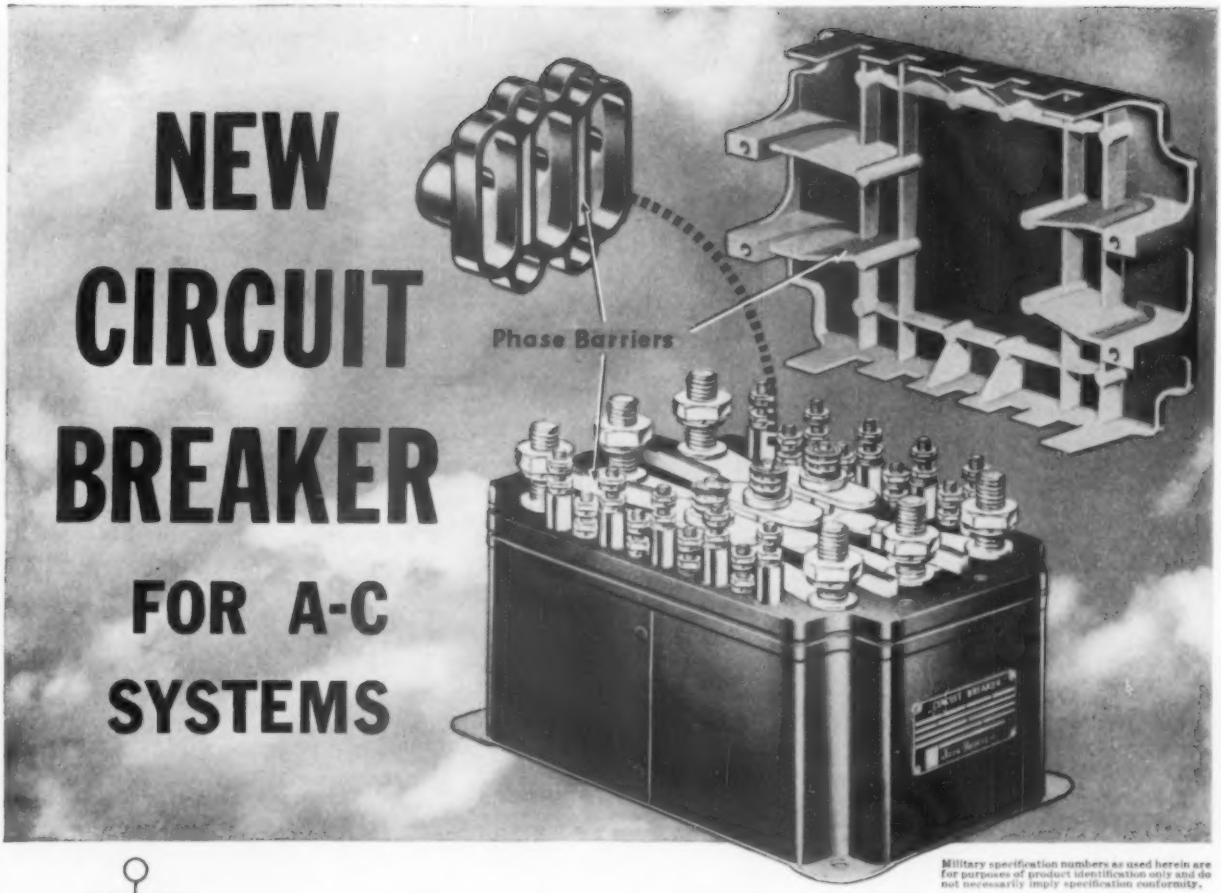
THRUST REVERSER NOZZLE incorporated in twin-engine pod. Bottom view shows reverser actuated, with turning vanes uncovered. Marquardt has achieved 50% thrust reversal.

sonic development is tied in with Boeing and Lockheed projects. Engines for these applications are being developed for speeds several times that of sound. The ramjet engines for the Boeing and Lockheed applications basically stem from the same engine with variations for their specific adaptions.

The basic engine is considered ready for initial production and has considerable potential for growth. It embodies refined inlets for good pressure recovery, a fuel injection system for good atomization over a wide range of pressure-altitudes, and a flame-holding mechanism which is very effective—previously a big problem in ramjet development.

▶ **Seminar Ahead**—Marquardt is plan-

NEW CIRCUIT BREAKER FOR A-C SYSTEMS



Military specification numbers as used herein are for purposes of product identification only and do not necessarily imply specification conformity.

Design features provide exceptional safety and ease of maintenance

This new Jack & Heintz Model 50086 Circuit Breaker is designed to meet MIL-C-8379A (ASG) . . . provides a continuous rating of 175 amperes (60 kva) . . . weighs but 4¾ pounds! Although an important part of the complete Jack & Heintz a-c system "package", it can be supplied as an individual unit if desired.

In addition to its main features described at right, this new breaker has many others that assure positive, trouble-free functioning under extreme environmental conditions. Here is another example of how Jack & Heintz continues to provide you with advanced electric systems and components through integrated engineering and manufacturing. For complete information write to Jack & Heintz, Inc., 17635 Broadway, Cleveland 1, Ohio. Export Department: 13 E. 40th St., New York 16, N.Y.

SAFETY FEATURES

Solid Copper Bus Bars
All bus bars are of solid copper. No flexible copper braids used!

Mechanical Phase Isolation
Straight-through path design of main conductors together with phase barriers permits complete mechanical phase isolation of all main conductors and contacts.

MAINTENANCE FEATURES

Easy Contact Inspection
As shown above, the special construction allows inspection of main contacts without disassembly.

Nylon Terminal Cover
Molded of high impact nylon, this cover can be removed easily by loosening four screws.

Accessible Auxiliary Contacts
All three connections for each auxiliary contact have been brought out to the terminal posts for ease of hookup.

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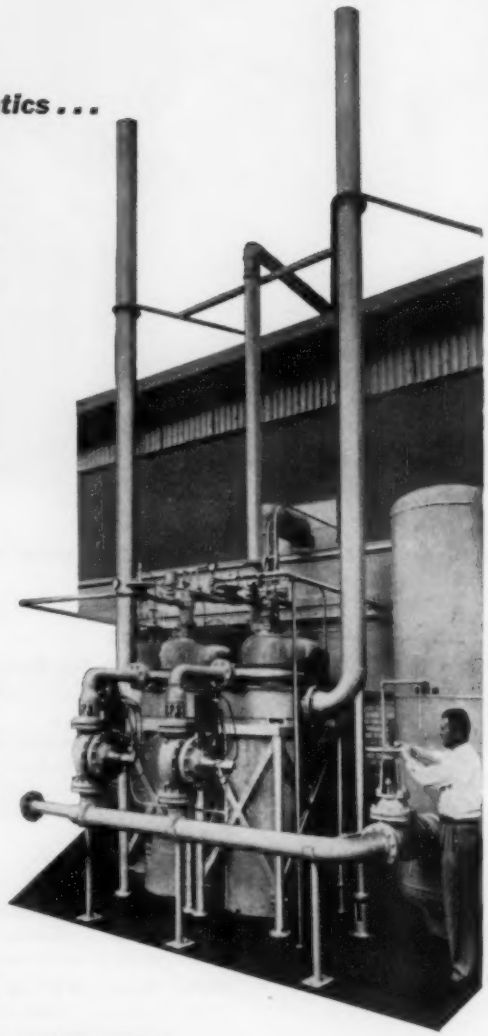
BOEING uses

THERMAL *heat exchangers . . .*

Ideally suited for testing pneumatics . . .

The extreme load change rates required to test air driven accessories and components for jet powered aircraft are easily and **quickly** obtained when your test facility uses THERMAL Type DF heat exchangers. Standard sizes are available from 750,000 to 8,000,000 Btu/hr duty — all rated at 300 psig and 1200 F. All may be gas, oil or combination fired and are complete factory built "package" units.



stress free design . . .

Years of trouble free service are assured by this simple yet remarkably compact design. The heater is two pass — counterflow. One pass is coiled to eliminate the need for expansion joints. Construction is all welded and all stainless steel — and guaranteed.

For complete information write for THERMAL Bulletin No. 105.

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MARQUARDT

Roy E. Marquardt, president of Marquardt Aircraft Co., at 37 can look back at an impressive record in teaching, research, development and manufacturing. He received his BS in Aeronautical Engineering in 1940 at California Institute of Technology, his MS at the same school in 1942.

Following this, he went to work for Northrop Aircraft, in charge of Navy research. At the same time he taught at the University of Southern California (he had also taught at Cal Tech) and became Director of Aeronautical Research at USC in 1944. Subsequently he left Northrop.

In 1944, Navy Bureau of Aeronautics gave USC a contract for the development of a 20-in. subsonic ramjet in accordance with Marquardt's specifications.

At this time Marquardt, with some engineers and business men, formed the Marquardt Aircraft Co. to subcontract the construction of the actual engine. Begun with a capital of only $1,000 in November 1944, Marquardt Aircraft today has more than 1,200 employes and sales running at a current rate of approximately $10 million per year. Marquardt's plant area is about 160,000 sq. ft.

ning a technical seminar for June on the West Coast. The company wants to bring together in a closed meeting a select group from the major airframe builders to reveal details of what this supersonic ramjet will do. It will also cover hydrocarbons and "exotic" fuels for speeds up to Mach 5.

Inquiries on this supersonic engine already have been received from several aircraft companies who are interested in using it as a source for thrust to augment that of the main engine at very high altitudes and speeds.

▶ **Housed in Tip Pod**—One way of utilizing a ramjet as an additional engine for this super-altitude, super-speed regime would be to house the engine in wingtip fuel tanks. These tanks would feed the main engines and be emptied before the main fuel tank would be tapped.

When the ramjet power was needed,

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Our engineering staff can help you select the right alloy and design the shape that best meets your product needs. Our modern extrusion facilities and complete die shops will then produce the shape to your exact specifications.

In a rush? Bridgeport's 16 extrusion presses and integrated die shops assure prompt deliveries. Need Technical Service? Our specialists are ready *now* to work out your light-metal problems. Call our nearest sales office for full particulars.

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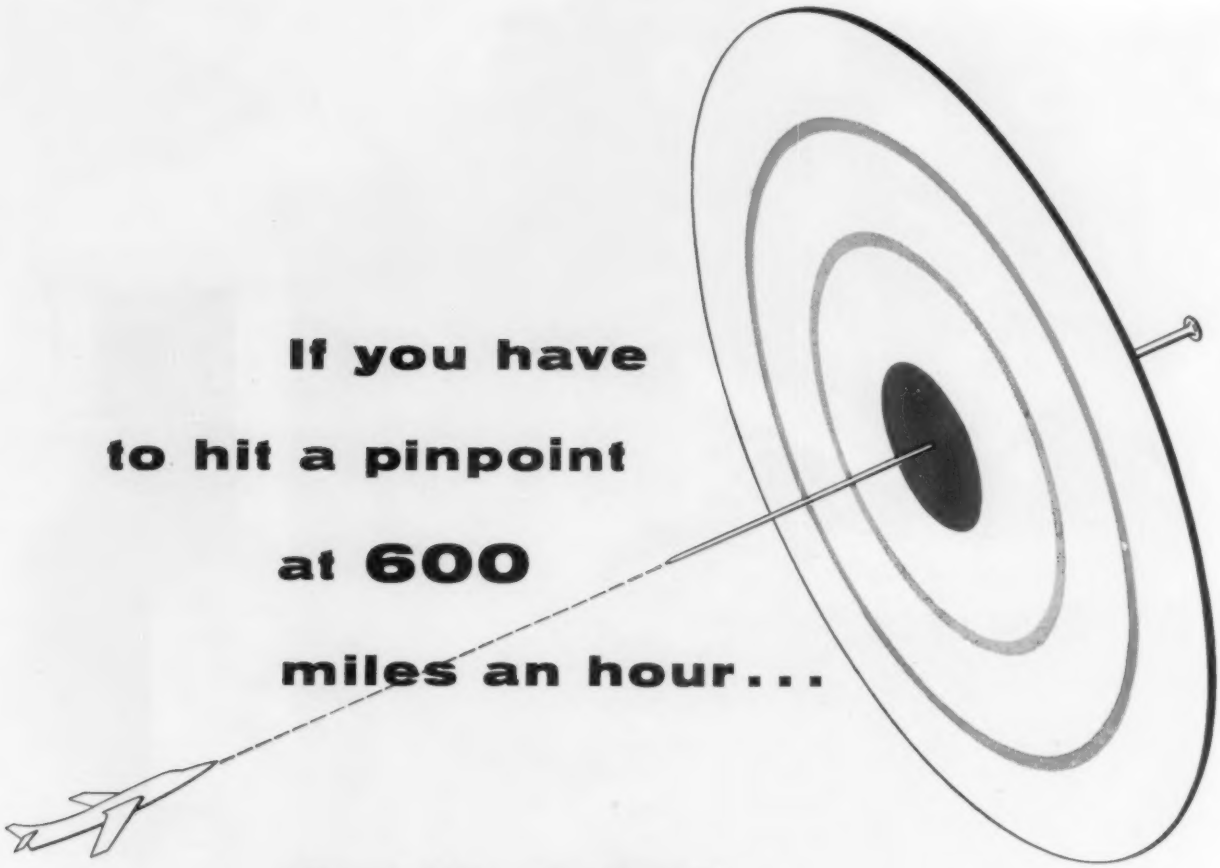


If you have to hit a pinpoint at 600 miles an hour...

Call AC!

For all the marvels among which we live, *actually* hitting a pinpoint at 600 m.p.h. is a miracle yet to be accomplished. But, AC has come awfully, awfully close.

Thousands of deadly Air Force fighter planes now guarding our far-flung frontiers are equipped with A-4 electronic gun-bomb-rocket sights built by AC. But, this gun sight is just one step along the way to pinpoint accuracy. AC is now exploring new methods for obtaining even greater accuracy, at the same time reducing size and weight of fire control systems.

More than 700 engineers at AC devote full time to electro-mechanical research, development and production. If you have a problem in this field, call AC.

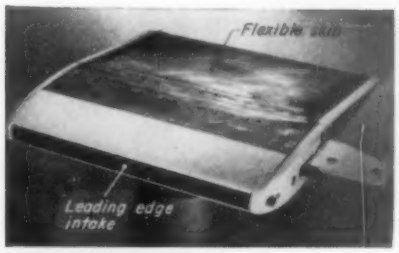
AC DEFENSE PRODUCTS

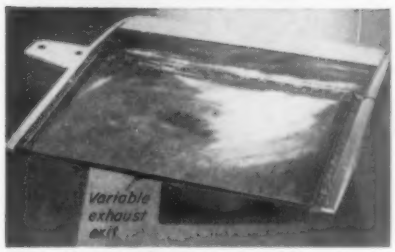
GM GENERAL MOTORS

Write for illustrated booklet "AC ... Engineering for the Future," now coming off the presses.

AC SPARK PLUG DIVISION • ELECTRONICS DIVISION OF GENERAL MOTORS CORPORATION • FLINT, MICHIGAN

DEFENSE PRODUCTS of High Quality at Low Cost DELIVERED ON TIME





FOR HELICOPTER BOOST, Marquardt developed this experimental, "two-dimensional" rotor-tip ramjet. Front view (top) shows leading edge intake. Trailing edge (bottom) has variable exhaust exist.

the nose and tail fairings on the tiptank would be kicked off and the ramjet fed with fuel from the aircraft tank. After the mission was completed, the ramjet could be dropped, if the pilot did not want to take the drag penalty.

► **Metal Slants**—Big problem with ramjets will be perfection of alloys that will take the extreme temperatures created by new fuels now in the research stage. One possible solution to this problem is the cermet (ceramic-metal combination); this type of material is under investigation in connection with ramjets now under development.

Materials now used are exclusively stainless steel, except for nose section housing, which is 24ST. Dow's HK31 sheet is being studied as a substitute for the 24ST, and also to extend its use further into the hot region to take temperatures of 600F, and to cut engine weight.

► **Afterburner Beginnings**—Marquardt made its entry into the afterburner field with a good basic complement of engineers who had piled up considerable know-how with McDonnell Aircraft Corp.

McDonnell had need for a special short afterburner for its F-101 Voodoo. As the engine industry was not prepared to build this unit, McDonnell set up its own afterburner organization. The company finally had to decide whether to stay in or get out of the afterburner business, and decided to get out. Marquardt saw the possibilities of the afterburner field and its similarity to ramjet work, and hired a group of 10 McDonnell engineers. Six of this original group are still with Marquardt; one of them is John Winter, now chief engineer of the powerplant division. He was with McDonnell from 1944 to 1952, associated for six of the eight years with powerplant work on ramjets, pressure jets and afterburners.

► **Advanced Projects**—Marquardt is engaged in afterburner and variable-area nozzle development for very advanced, high-power jet engines, now in the development stage.

Key goals in this Marquardt development project are to boost combustion efficiency and refine the metallurgy of the afterburner for higher temperature applications.

One of these big thrust engines already has been run on the test stand with its afterburner installed but inoperative, while the nozzle has been used.

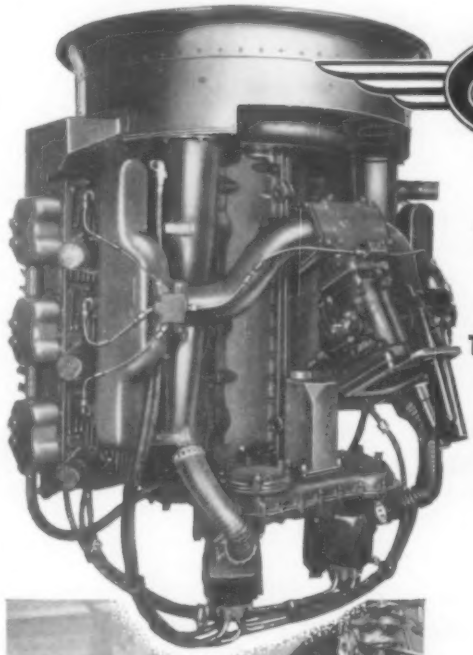
Marquardt's work on variable-area nozzles is believed to incorporate convergent-divergent flow principles for supersonic applications. This convergent-divergent arrangement might be obtained physically (with metal) or dynamically.

► **Small-Jet, VTOL Studies**—Marquardt is now making proposals to construct afterburners for some of the small, lightweight relatively high-thrust turbojets. Company engineers have come to the conclusion that it is feasible to design a very lightweight afterburner to greatly boost the performance of this type of small jet engine.

Some of the thrust-to-weight ratios

New compound-type piston engine

of unmatched efficiency in the small engine field



Franklin

0-425-13

TURBOSUPERCHARGED

•

300 BHP

T. O. - Sea Level to 10,000 ft.

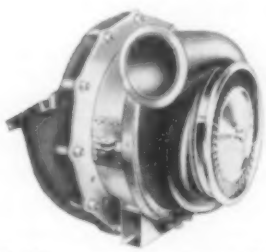
•

1.55 lb/hp

specific weight of engine-turbo combination for helicopter installation (as shown, left).

1.43 lb/hp

for fixed wing aircraft



Turbosupercharger supplies 40" mercury absolute pressure at carburetor inlet up to 16,000 ft. Weight only 36 lbs.

0 - 425 - 13 engine and turbo as installed in Army H-18 helicopter.

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ESSO AVIATION TURBO OIL 35

ONLY OIL APPROVED FOR LUBRICATING VICKERS VISCOUNT TURBO-PROP ENGINES

An exclusive Esso achievement... Esso Aviation Turbo Oil 35, a synthetic product, is the *only* gas turbine lubricating oil approved by Rolls-Royce, makers of the four "Dart" turbo-prop engines powering the Viscount "700" Series.

Only a *synthetic* lubricating oil can meet all the exacting requirements of these turbine engines; they cannot be met completely by a mineral oil, even of the highest quality.

This is another Esso "first," result of technical *research* and *foresight* on the part of Esso aviation lubrication specialists working in close cooperation with British and U. S. aircraft engine designers and builders.

All of these airlines rely on
Esso Aviation Turbo Oil 35
for propeller turbine engine lubrication of their Vickers Viscounts, the first and still the only turbo-prop aircraft in scheduled service:

- British European Airways
- Air France
- Aer Lingus
- Trans-Australia Airlines
- Trans-Canada Air Lines
- Capital Airlines
- British West Indian Airways

Esso

INTERNATIONAL AVIATION PETROLEUM SERVICE

involved with this type of engine fitted with afterburner may run about 12:1, AVIATION WEEK has learned.

Marquardt also has begun studies of various forms of afterburning devices to supplement jet engines in VTOL aircraft.

▶ **Work for Westinghouse**—The company is conducting combustion development work for Westinghouse, checking the feasibility of various burner configurations for future afterburner applications. This work is being done in the Long-Range Planning and Research Division.

Bulk of the company's afterburner work has been in conjunction with the Westinghouse J40 and J46 powerplant projects.

The J40 afterburner nozzle had a unique expander seal made of L605 backed with a high-temperature fiber glass packing retained with an end cap. This makeup was necessary because the temperature at the surface of the afterburner nozzle was in the region of 1,800-2,000F.

When the -24 version of the J40 engine was canceled, Marquardt's development work on the specific afterburner also ended. Work also was completed on the afterburner for the J46, but Marquardt engaged in additional altitude development work in its own test facilities by simulating airflow swirl and pressure normally associated with the turbine.

▶ **Titanium Welding Development**—In connection with afterburner shroud research and general metallurgical development, Marquardt is investigating the problems of welding titanium and its alloys.

For resistance-welding of the material, Marquardt technicians have developed a technique of preheating the sheet at the weld area by resistance-heating in the welding machine. This insures a weld ductility comparable to the base metal.

This technique permits use of a lower welding heat input and for a shorter time. This also minimizes oxygen and nitrogen at the weld area.

A postheat treatment is used to control the cooling rate. This postheating is the reverse of the pre-heating cycle—reduction in welding machine's current. In effect, postheating is a slight annealing action.

▶ **Thrust Brake Work**—Reverse thrust development at Marquardt is company-financed. Marquardt engineers believe that reversers will offer a big field, and most thrust reversers will be tailored applications—there will be no shelf package configuration. Nevertheless, it is not felt that the reverser is as much a part of the powerplant as is the afterburner.

Basic work in the reverser field at Marquardt has been developed along the concept of turning vanes and mechanical blockage (extending pie-segment scheme). With this arrangement, a reverse thrust of about 50% has been achieved, with the forward flow directed at about 45 deg. to the centerline of the jet.

This 45-deg. angle is desired to assure good dilution with the ambient air to prevent recirculation of the hot exhaust gases into the engine inlet—a condition somewhat pronounced with engine pod installations.

Marquardt also is working on other reverser configurations. These are target types which afford up to 80% reverse thrust, but in actual practice it may be necessary to reduce this percentage because of the problem of recirculation of hot gases into the engine inlet, the company believes.

Some value between 50% and 80% reversal can be achieved, it is felt, and this would be a good goal.

Marquardt is not working on this target type of reverser under contract now, but it may end up as a military installation shortly. It may include a few turning vanes to direct the reverse exhaust away from the skin.

(This is the first of two articles on Marquardt Aircraft Co. developments in aircraft propulsion.)

prankish MOODBEAMS #5

While papa blissfully dreams about Southwest Airmotive ads, mama sneaks in with an April First Hotfoot. For technical-minded readers, prankish mama is Pat Ferguson, 20, 5'6", 125 lbs., black-haired, brown-eyed.

Papa, being a pilot, is used to this kind of carryin'-on, regularly suffering through a torture known as The Olde Promised Delivery Date Hotfoote, applied each time his flying machine gets into the shop for a check or overhaul. Getting the darned thing back out again is even tougher than getting a foot out of a frying Texas boot.

We have this to say to papa: The Southwest Airmotive Aircraft Division now has a plan whereby you WILL get your plane on the Promised Delivery Date. Write our Service Rep for details.

— And we have this to say to mama: Cut that out, now — those boots cost 60 dollars!

Southwest Airmotive COMPANY LOVE FIELD DALLAS

New Titanium Plant Gets Amortization Aid

E. I. du Pont de Nemours & Co. was awarded a $40 million certificate of necessity with 90% allowed for rapid tax amortization for a titanium metal sponge facility at Johnsonville, Tenn., by Office of Defense Mobilization.

Other certificates of necessity include:

Cambridge Instrument Co., Ossining, N. Y., electronic components, $52,600 certified with 45% allowed.

Boeing Airplane Co., Seattle, Wash., research and development of military aircraft, $841,818 certified with 60% allowed.

Forrest Wagniere Engineering Co., Culver City, Cal., military aircraft parts, $8,070 certified.

Kearfott Manufacturing Corp., Newark 7, N. J., military aircraft parts, $38,083 certified with 65% allowed.

Ronson Corp., Newark, N. J., aircraft parts, $2,780 certified with 65% allowed.

Fairchild Engine & Airplane Corp., Fairchild Aircraft Division, Hagerstown, Md., military aircraft, $6,500 certified with 60% allowed.

Farrand Optical Co. Inc., New York, N. Y., scientific instruments for military end items, $16,540 certified with 65% allowed.

Ryan Aeronautical Co., San Diego, Cal., military aircraft engine components, $59,779 certified with 65% allowed.

National Gage Die Co., Inc., Agawam, Mass., military aircraft parts, $29,417 certified with 70% allowed.

Hydraulic Research & Manufacturing Co., Burbank, Cal., military aircraft parts, $23,447 certified with 70% allowed.

Bell Aircraft Corp., Fort Worth, Tex., military helicopters, $57,633 certified with 60% allowed.

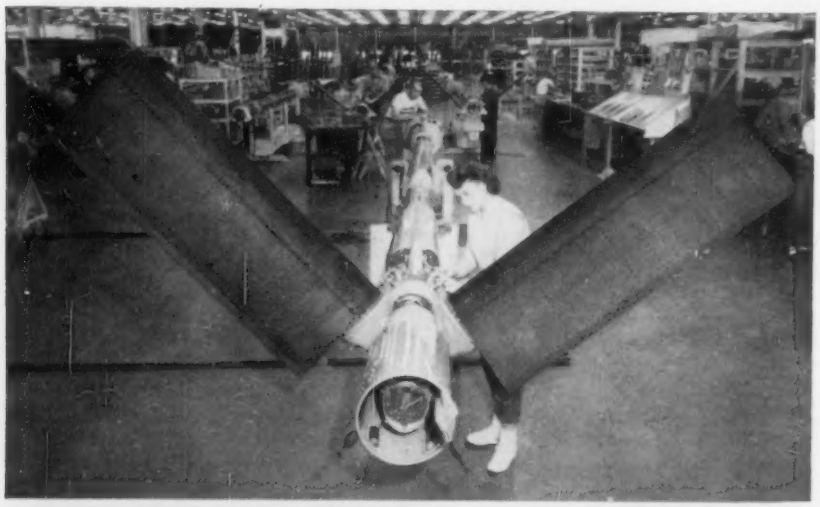
The Cornelius Co., Minneapolis, Minn., military aircraft parts, $31,800 certified with 70% allowed.

Mid-Texas Telephone Co., Killeen, Tex., military communications facilities, $44,694 certified with 65% allowed.

Motorola, Inc., Riverside, Cal., research and development, $502,601 certified with 50% allowed.

Thompson Products, Inc., Cleveland, Ohio, aircraft engine components, $1,566,142 certified with 65% allowed.

Western Electric Co., Inc., Winston-Salem, N. C., military electronic equipment, $690,820 certified with 75% allowed.



Getting Set for Thirsty Stratojets

These production and installation photos show components of the inflight refueling equipment in Boeing's KC-97 tankers. In the picture above, a Flying Boom receives final touches as it nears end of Renton, Wash., assembly line. Below left, a storekeeper inspects stock of outer casings for the Flying Booms. Below right, aerial refueling tank is being brought up through the plane's cargo hatch for installation in the tanker's upper deck. Total of 15 tanks are carried, two-high, on KC-97G's port side. Earlier versions the KC-97E and F, carried four larger tanks instead. Refueling pod, boom and tanks are removable for conversion of the plane to transport use. Strategic Air Command's table of organization calls for a squadron of 20 KC-97 tankers for each 45-plane wing of B-47 Stratojet bombers. Strategic Air Command currently is running inflight refueling operations at the rate of approximately one each 3.5 minutes.

MIT Offers Course On Automatic Tools

Numerical control of machine tools, a step toward the ultimate concept of the automatic factory, will be studied in a special summer course available to industry personnel at Massachusetts Institute of Technology.

MIT says the program will be directed toward persons who want to get a broad understanding of the problems of numerical control. Preference will be given to applicants now working in the design or application fields of automatic machine tools, or who anticipate entering such a field.

Part of the two-week session, held from Aug. 22 through Sept. 2, will be spent in group preparation of a program for machining a work piece, followed by actually doing the job on the numerically controlled milling machine developed by the Servomechanisms Lab of MIT under USAF contract.

For information: Summer Session office, Room 7-103, Massachusetts Institute of Technology, Cambridge 39, Mass.

PRODUCTION BRIEFING

▶ **AiResearch Manufacturing Co. of Arizona**, Phoenix, has shipped its 1,500th gas turbine used for engine starting and other aircraft services.

▶ **Production savings** of $100,000 annually have resulted from installation of two-way closed-circuit ffmm installation connecting 30 transmitter-receivers at fabrication and subassembly stations, according to Lockheed Aircraft Corp., Burbank, Calif. System is superimposed on plant's public address system.

▶ **Airborne Accessories Corp.** has expanded floor space 50% with erection of an additional building in Hillside, N. J. New facility provides additional development, engineering and experimental shop space.

▶ **Data reducing system** made by Systems Division of Consolidated Engineering Corp., Pasadena, Calif., has

America's finest service facilities for business aircraft!

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WE ALSO SPECIALIZE IN rebuilding and modification. Our custom interiors are unsurpassed for beauty, utility and comfort. Satisfied customers include Continental Oil, The Texas Company, Douglas Aircraft, Thompson Products, National Cash Register, Chicago Tribune.

USE OUR NEW radio service center. Now available for the first time for business aircraft are the kind of complete electronics facilities previously available only to the airlines.

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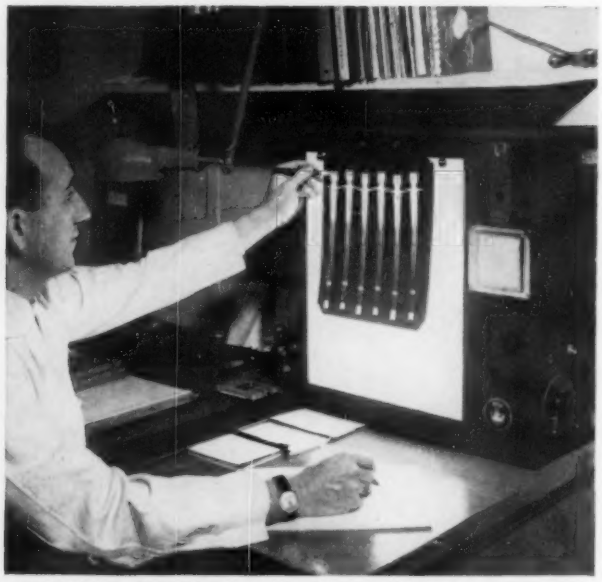
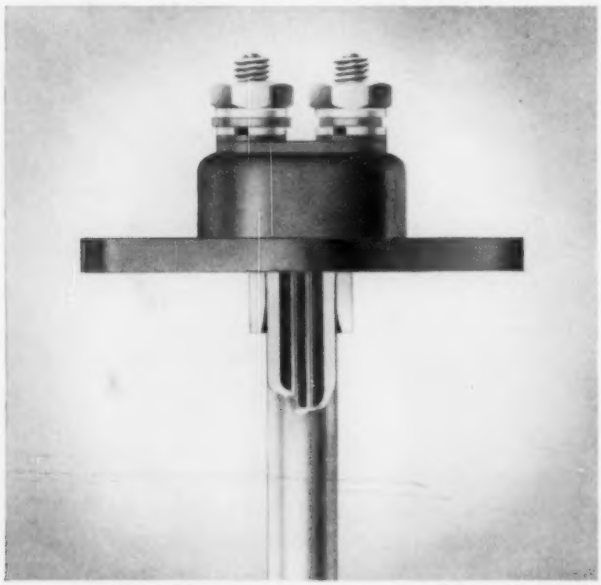
Los Angeles International Airport, Los Angeles 45, California

How Fenwal Thermocouples add certainty to modern flight

1. FOR PROTECTION IN FLIGHT Fenwal Thermocouples keep jet pilots *accurately* informed on heat conditions inside gas turbine aircraft engines. They are ever alert to indicate and/or control critical high temperatures — to protect both pilot and plane in flight. Fenwal *custom-designs* a full line of Aircraft Gas Turbine Thermocouples for all jet engine needs.



2. X-RAYED FOR QUALITY at crucial stages of production, every Fenwal Thermocouple also undergoes further exacting tests for dependability. These include calibration inspection against Government Standards, double-checks for insulation resistance throughout operating temperature range, flame tests to assure fast, accurate response for extra safety in flight.



3. EXCLUSIVE "BELL MOUTH"* within the collar of Fenwal Thermocouples cushions and spreads vibration strain and eliminates high point-of-stress concentration. This means longer Thermocouple life. It is but one of many *Fenwal firsts* evolved during Fenwal's custom-engineering of *over 40 special types* of thermocouples . . . each *precision-engineered* to engine manufacturers' specifications for peak performance.

4. FOR MORE FACTS about Fenwal Aircraft Gas Turbine Thermocouples see Fenwal's new illustrated brochure. Fenwal — already a leader in the Aircraft Over-Heat and Fire Detection field — is fast becoming a leading supplier of custom-designed thermocouples for temperature indication and/or control in jet aircraft. Write for *your* copy of this brochure now to **Fenwal Inc., Aviation Products Division, 124 Pleasant Street, Ashland, Mass.**

Fenwal **AIRCRAFT GAS TURBINE THERMOCOUPLES**

Sense temperatures precisely . . . to fit your needs

*Pat. pending

been installed by Marquardt Aircraft Co., Van Nuys, to speed processing ramjet engine test information.

▶ **Raycon Corp.,** maker of highspeed mechanical counters, moved to 248 Harbor Blvd., Belmont, Calif.

▶ **Aircraft Products Divisions** of Century Controls Corp., Farmingdale, N. Y. appointed Snyder Engineering Co., Tulsa, Okla. as manufacturer's representative for Texas, Oklahoma, Kansas and Missouri.

▶ **Brubaker Tool Corp.,** Millersburg, Pa., purchased Morton Machine Works, Detroit, for $500,000. Morton facilities will be moved to Millersburg. New division makes parts, clamps, camp assemblies and fixture components.

▶ **Integrated micrographic system** is a new method of miniaturizing documents, maps and graphic material to 100 times or so linear, developed by Photogrammetry, Inc., Silver Spring, Md., for the Office of Naval Research. IMS comprises three principal parts: reduction copy panel, processor and duplicator. Copy unit uses either 35-mm. or 70-mm. color or black-an-white film.

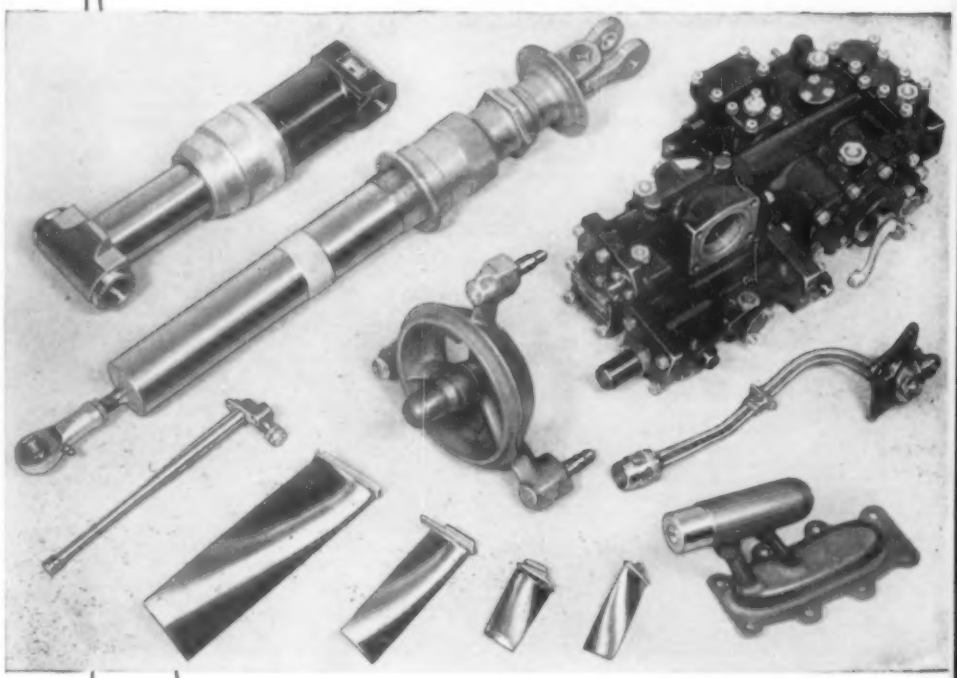
▶ **Datran Engineering Corp.,** maker of transducers and electro-mechanical equipment, moved to Mid-Continent Manufacturing, Inc.'s, Manhattan Beach, Calif., facility. Datran is a Mid-Continent subsidiary.

Plastic Tent Allows "Clean" Titanium Welds

Because molten-state titanium absorbs many gases from the atmosphere that tend to embrittle welds, Solar Aircraft Co., Des Moines, uses this sealed vinyl plastic tent to keep air away from fusion welds while work is bathed with an inert gas. The gas-tight zippered tent is fastened to standard welding table. The operator uses long rubber gloves that are attached to the transparent bag to allow freedom of movement.

Jet Parts and Assemblies

TO YOUR SPECIFICATIONS



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53-3

USAF Contracts

Following is a list of recent USAF contracts announced by Air Materiel Command.

Aerojet-General Corp., Azusa, Calif., rocket, sounding, 23 ea., beacon extension, 26 ea., battery extension, 31 ea., $426,691.

American Bosch Corp., Springfield, Mass., vibrator assys., $510,003.

American Machine and Metals, Inc., United States Gauge Div., Sellersville, Pa., indicators, 2,032 ea., $184,249.

Bendix Prod. Div., Bendix Aviation Corp., South Bend 20, Ind., brake assys., 67 ea., $50,114.

Scintilla Magneto Div., Bendix Aviation Corp., Sidney, N. Y., coil assys., $67,196.

Cathedral Films, Inc., Burbank, Calif., motion picture release prints entitled "The St. Paul Series," $120,115.

Chicago Aerial Industries, Inc., Melrose Park, Ill., detectors, 125 ea., converters, 125 ea., $180,763.

Eclipse Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., transmitters, hydraulic pressure, $195,968; indicators, 626 ea., $198,260; transmitters, 1,399 ea., $594,575.

Eicor, Inc., Chicago 7, alternators, engine-driven, 341 ea., $91,323.

General Electric Co., X-Ray Dept., Milwaukee, maintenance tools and test equipment, $105,840.

Goodyear Tire and Rubber Co., Akron 16, brake assys., 940 ea., $175,451.

Gordon Enterprises, N. Hollywood, Calif., spare parts cameras, $174,223.

Indiana Gear Works, Inc., Indianapolis, facilities for the production of helicopters gears, $1,000,000.

Ketay Instrument Corp., New York 12, true airspeed indicators, 360 ea., $42,839; indicators, tachometer, $76,140; transmitters, 467 ea., $190,008.

Kollsman Instrument Corp., Elmhurst, N. Y., altimeters, pressure, 235 ea., $26,765; 1,298 ea., $134,402.

Propeller Div., Curtiss-Wright Corp., Caldwell, N. J., CT634S-E prop, 1 ea., synchronizer assy., 1 ea., spinner assy., 1 ea., $40,761.

Pacific Div., Bendix Aviation Corp., N. Hollywood, misc. actuators, timers and data, $98,403.

Seaboard Elec. Co., New York 13, flashers, 2,628 ea., $93,267.

Westrax Corp., New York 11, recorders, 10 ea., $57,850.

Winslow Co., Inc., Newark 5, N. J., indicators, $37,290.

Adel Division, General Metals Corp., Burbank, Calif., motor assys., 343 ea., fluid metering pumps, 60 ea., 65 ea., $37,810.

Aircooled Motors, Inc., Syracuse, special tools for O-425-1 engines, $30,000.

Aircraft Radio Corp., Boonton, N. J., radio sets, components, spare sets, spare parts, data and test equipment, $268,273.

Bendix Products Div., Bendix Aviation Corp., South Bend 20, Ind., brake assemblies, 326 ea., 384 ea., 449 ea., $3,522,476.

Continental Aviation & Engrg. Corp., Detroit, engines, 18 ea., starter generators, 18 ea., $375,206.

Douglas Aircraft Co., Inc., Long Beach, Calif., facilities for engineering flight test of B-66 and F-102, $2,200,000.

Ex-Cell-O Corp., Lima, Ohio, facilities for compressor wheel assembly, $200,700.

Goodyear Tire & Rubber Co., Inc., Akron 16, wheel assys., 110 ea., brake assys., 110 ea., wheel assys., main, 86 ea., $113,809.

Kollsman Instrument Corp., Elmhurst, N. Y., indicators, airspeed, $2,049,388.

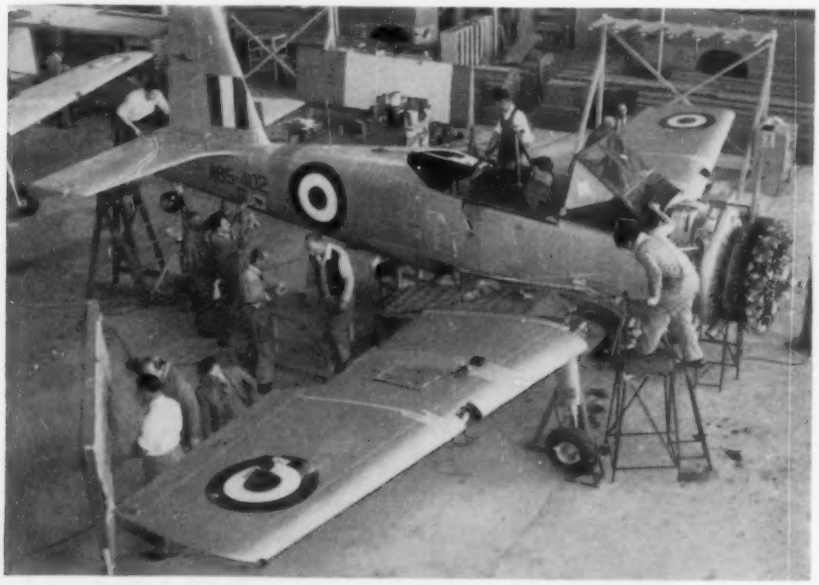
Lockheed Aircraft Corp., Marietta, Ga., procurement of C-130A-1, 1 ea., $455,980.

Lycoming Div., Avco Mfg. Corp., Stratford, engines, special tools, 20 ea., $494,-400; engines, special tools, 46 ea., $1,341,-300; engines, 43 ea., special tools, 72 ea., $3,365,690.

Ruthrauff & Ryan, Inc., New York 17, insertion of USAF recruiting ads in Scholastic Magazine, 10 ea., Scholastic Roto, 6 ea., $57,000; Mechanix Illustrated, 4 ea., Popular Mechanics, 4 ea., $26,740; advertising space in Sunday newspapers, 4 ea., 16 ea., 16 ea., $32,065.

Sojerberg Mfg. Co., Inc., Alhambra, Calif., lights, cockpit, 25,726 ea., $127,858.

Vectron, Inc., Waltham, Mass., recorder groups, 41 ea., 10 ea., $1,518,743.



Australians Begin Trainer Production

Production model C.A.22 Winjeel (Young Eagle) nears completion at Commonwealth Aircraft Corp.'s plant at Fishermen's Bend, Australia, more than four years after the prototype made its first flight. Production rate is unlikely to exceed one plane weekly, Aviation Week is informed. Winjeel seats pilot and instructor side-by-side, and there is room for an additional occupant behind them. Powerplant is a 450-hp. P&W Wasp Jr. Top speed is given as 180 mph. and rate of climb as 1,500 fpm. The Winjeel will replace the Wirraway and Tiger Moth trainers in the RAAF.

PLASTIC TANK cracks when jettisoned.

Plastic Drop Tanks Go Into Production

Droppable plastic fuel tanks that will break on impact are going into production for the Air Force in a program aimed at replacing aluminum tip and underwing units that could be salvaged and reused by an enemy.

Molded Products Corp., division of Admiral Corp., is building the 225-gal. tanks under a contract awarded by USAF's Air Material Command in June 1952.

▶ **450-Gal. Tank**—As Molded Products entered the production phase, Air Research and Development Command confirmed an AVIATION WEEK report that a 450-gal. fibrous glass-reinforced plastic tank is being developed by Zenith Plastics Co.'s Aircraft Division (AW Jan. 3, p. 34).

This tank will be manufactured in separate pieces for assembly and bonding in the field.

▶ **Weight, Cost**—The 225-gal. tanks weigh 115 lb., compared with 99 lb. for an aluminum unit able to carry the same volume. But ARDC said engineers believed it will be possible to reduce the plastic tank's weight to a level equal to aluminum.

Cost of the plastic tank, ARDC said, is comparable with aluminum.

Lightweight Ducting

Development of thin-gage Uniloy 1919DL makes possible important weight savings in aircraft ducting, compared with Type 321 corrosion-resistant stainless steel, Flexonics Corp. states.

The company reports that a primary heat exchanger line fabricated of 19-9DL weighs 0.92 lb., compared with 1.33 lb. for Type 321 material. The thin-gage uniloy can also handle higher temperatures and pressures, it is reported.

Flexonics Corp., Maywood, Ill., is fabricating the new material in straight-wall tubing and convoluted members.

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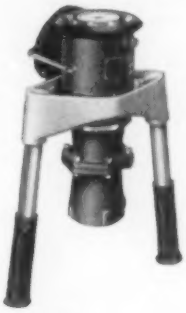
NO. 4092 SINGLE POINT FUEL NOZZLE



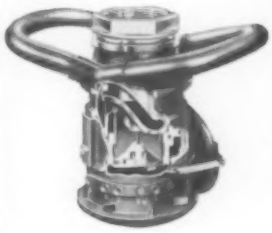
A self-sealing coupling valve, No. 4092 is quickly and easily connected for refueling or defueling. Unusually low pressure drop. Self-adjusting; fits any qualified adapter. Couples, locks and controls flow in one motion. No auxiliary controls. Seals automatically when disconnected.

NO. 4083

Has aluminum elbow; qualified for military use.

Patented 2,665,925
2,665,926

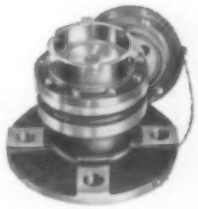
NO. 4093 SELF-SEALING HYDRANT VALVE



Aside from stirrup handles, No. 4093 is like No. 4092 Fueling Nozzle. Used widely in hydrant systems for pipe lines with pits or above ground.

Patented 2,665,925
2,665,926

NO. 4096C HYDRANT ADAPTER



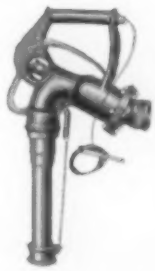
Sturdy brass construction, 2½" standard flange, generally installed in manhole or pit on apron. Used in conjunction with No. 4093, combination can be used for fueling or defueling.

NO. 4082 OIL SERVICING NOZZLE

Also designed and built to military specifications, this nozzle delivers lubricating oil to aircraft. Features positive shut-off, non-drip valve in end of tube. Easily removable 60-mesh brass wire strainer.

NO. 775M AIRCRAFT REFUELING NOZZLE (OVER-WING)

Has passed rigid tests under adverse conditions to qualify for satisfactory refueling of military airplanes. Widely used at commercial airports. Brass or aluminum.



BUCKEYE IRON & BRASS WORKS, Dept. AW
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Please send details on ☐ No. 4092, ☐ No. 4083, ☐ No. 4093, ☐ No. 4082, ☐ No. 775 M.

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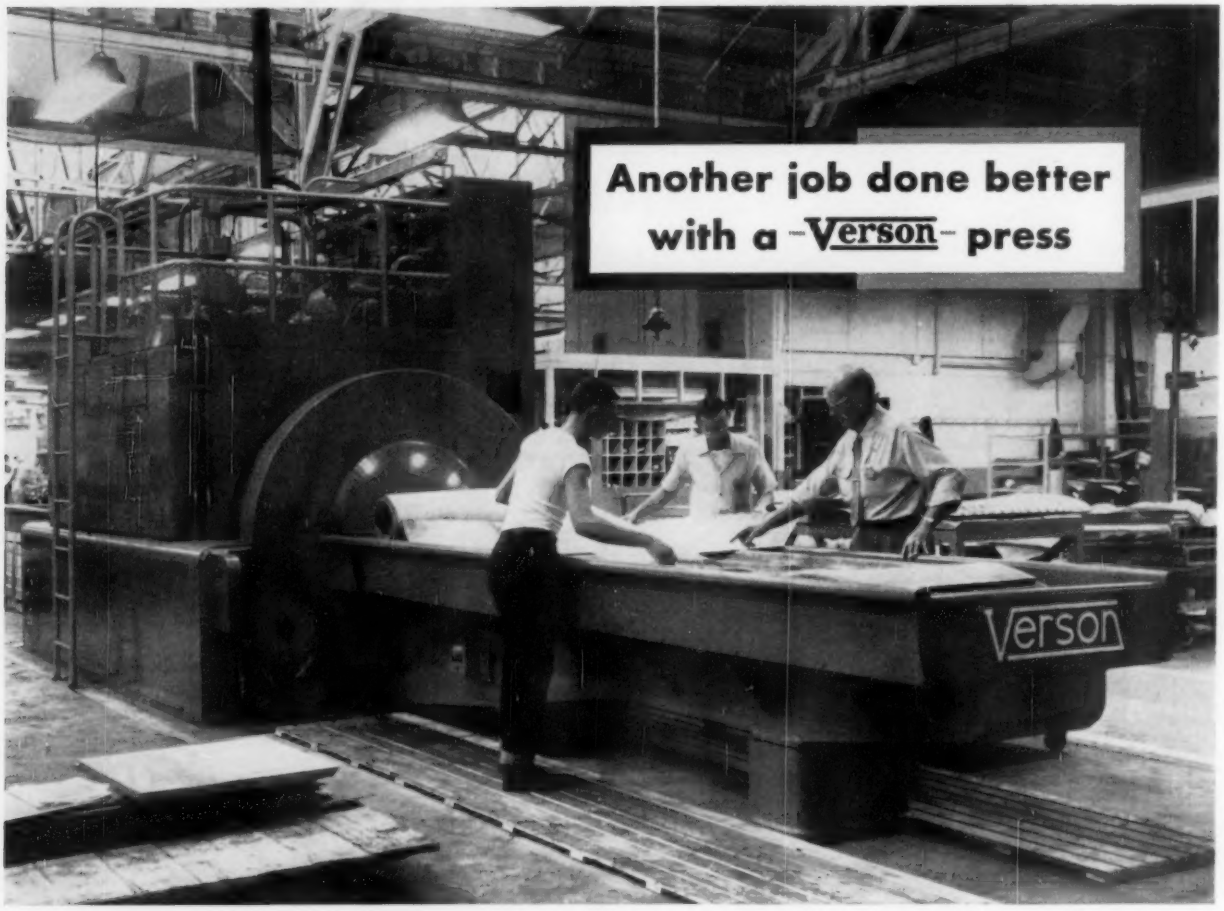
CITY_____ STATE_____



19,440 Tons of Force Forms F-89D and B-62 Parts in this Verson-Wheelon Press at Northrop . . .

Specifications, operating data and illustrations of typical jobs are given in the Verson-Wheelon Bulletin. Write for your copy, today.

A key part of Northrop Aircraft's facilities for the Scorpion F-89D and Snark B-62 programs is this Verson-Wheelon Direct Acting Hydraulic Press. Rated at 19,440 tons capacity, this Verson-Wheelon is used for rubber pad forming of aluminum and steel parts.

The Verson-Wheelon Press offers many advantages over conventional rubber pad forming presses. It is lower in first cost and more efficient in operation. The use of twin loading tables makes it possible to load one table while the other is in the pressing chamber. Most parts are completely formed in the press without need for hand finishing.

If you do rubber pad forming or short run forming, investigate the Verson-Wheelon Press. A complete range of tonnages is available from 1200 to 42,000. For recommendations, send an outline of your requirements.

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58

LETTERS

DME vs. Tacan

I have just finished reading your editorial of 28 March on "Military Tacan vs. Civil DME—a Bad Mess." It has moved me—this is the second time in my entire life that I have done so—to write you my personal appreciation.

Really there are very few people that I know of who are completely inside of all of the facts in this case that could have done such a thorough and accurate job. The fact that it was well written I would have expected—that you were able to collect the number of facts that you have is outstanding.

I have called Mr. Quarles' attention to this very fine piece of writing and I am sure he feels about it the same way I do.

J. Francis Taylor, Jr.
Director
Air Navigation Development Board
Civil Aeronautics Administration
Washington 25, D. C.

Honest Disagreements

This is just a note to thank you for your reporting in the VOR/DME common system vs. Military Tacan controversy. It is great help to us, who are so close to this problem, to have the opportunity to get new viewpoints, such as you present in your excellent editorial of Mar. 28th.

Certainly, if there were no contention in this picture, there would be no controversy. The honest disagreements which exist make the overall problem difficult to present with a fairness which will satisfy all protagonists. Your editorial serves to re-emphasize the vital necessity for all parties to be factual in their partiality.

Phil Klass, your able Avionics Editor, has done the industry a service by presenting pertinent facts regarding the Tacan proposal, which would otherwise have been difficult for the many interested and affected parties to this issue to learn for themselves.

You, in your editorial, present these facts against the background of an air defense requirement which we certainly cannot and do not question.

To continue with constructive addition to this record, we would like to suggest your serious consideration of the following:

- The effect of Tacan, or a lack of Tacan, on the air defense systems of Western Europe and North America should be carefully balanced against the years of constructive air navigation planning in ICAO, which has resulted in the international standardization of common system VOR and DME.
- If we grant ANDB's proposal that Tacan be adopted as a common system objective, it would seem that the controversy does involve more than the question of whether or not to limit the operation of the current civil DME.

The issue under consideration would seem to be a realignment of the common system objectives and should, therefore, be undertaken only with a complete review of the interlocking aspects of these objectives as they fit the future of the whole program of navigation and communications in air traffic control.

"We suggest that it is premature to regard this controversy as affecting only the DME when, in fact, we are considering a step which will also affect azimuth measurement, approach and landing, data transfer, communication, situation display and all related facilities in the eventual future.

- To set the record straight, neither our files nor our memories contain any knowledge of a written warning from the military that the airborne DME program "was a highly speculative venture." We pursued this program in good faith and in full coordination with the cognizant government agency involved. We and other manufacturers have done so before and feel that this kind of coordinated "speculation" is a valuable contribution to the tremendous progress that the aviation industry has made in the past decade.

We sincerely hope that such free enterprise can continue to contribute its share to this progress.

G. F. Quinby
Sales Manager
National Aeronautical Corp.
Ambler, Pa.

VTO? SGA? What?

The variation in types of new aircraft capable of vertical or near vertical ascent or descent creates a problem in nomenclature.

For example, the term VTO could be

You're the only one we haven't heard from. According to the tremendous response that we've had for our "Celastic" booklet, we figure you're just about the only one who hasn't written. So join the crowd... we know you won't be sorry... Write now, right now!

WE'VE GOT A BOOKLET DESCRIBING

Celastic "the miracle plastic"

just waiting for your letter of request! This is the fabulous plastic that you cut from soft sheets, soften in a liquid softener, mold or shape any way you want and let it harden—that's all! "Celastic" has a million uses, you'll be interested in at least one of them. So, write now for your copy of this free booklet, it will be sent to you by return mail.

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SKYLINE PRODUCTS INC.

GRAND BOULEVARD, DEER PARK, NEW YORK

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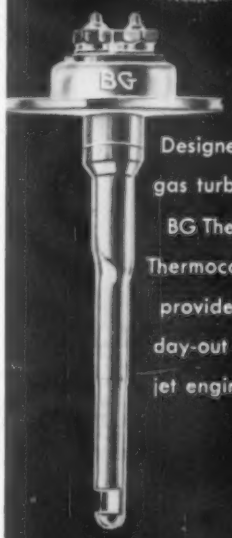

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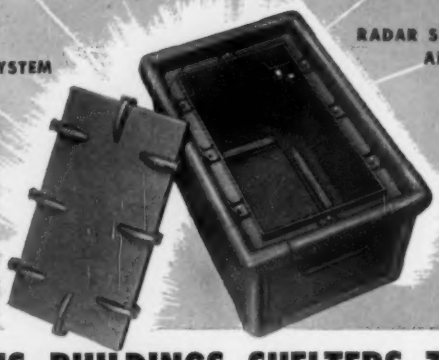

AND VANS, BUILDINGS, SHELTERS, TRAILERS
for systems such as AN/TRN-6, AN/TRT-3, AN/FPN-16, AN/MRN-12, AN/MRN-14 (XW-1)

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applied to helicopters and convertiplanes as well as to the Lockheed and Convair prototypes. The Flying Bedstead, the Bell vertical riser could also be included in the VTO category. The applications of boundary layer control and circulation control may bring comparable performance to more conventional aircraft.

We propose the use of the term Steep Gradient Aircraft (SGA) to denote this new class of aircraft. The conventional aircraft could be distinguished from SGA by the term TGA, i.e. Tagential Gradient Aircraft.

Perhaps your readers have better thoughts on this not too important problem.

JEROME LEDERER
The Daniel & Florence Guggenheim Aviation Safety Center at Cornell University
471 Park Ave.
New York 22, N. Y.

Industry Defender

Mr. Moesel's letter (AW Mar. 7, p. 37) sounds like sour grapes, and I can see no reason for publishing such a letter in an aviation magazine. In fact, I feel somewhat ashamed for having subscribed to a publication which displays so little pride in the industry it is supposed to represent.

Are you going to let this iron worker tell the world that your magazine chronicles the haphazard doings of a slipshod industry? One look at Mr. Moesel's letter and the congressman from Podunk will demand that all aviation appropriations be stopped immediately.

▶ **'War Babies'**—So, there has been no advance in 30 years? It so happens that I have spent just about 30 years in what Mr. Moesel refers to as an inefficient and incompetent industry, and it burns me to read complaints from "war babies." Mr. Moesel must have a lot to offer if it took him more than 10 years to find a job in aviation.

The big build-up started about 1939, and most factories had cleaned house by 1947. Between 1939 and 1947, the aviation industry was forced to take whatever they could get in the way of manpower to fill the gaps created by an expansion that was unprecedented in any industry. Factories had to hire men who knew nothing at all about airplanes, and they even hired some who believed that airplanes are built like bridges. When we start building airplanes to the standards of bridge construction, you can forget all of your pet peeves about the aviation industry—there will be no aviation industry.

▶ **"Reasonable Return"**—I do not dispute that there is a shortage of trained, experienced aeronautic engineers; but, like any other industry, the aviation industry expects a reasonable return on its investment. In demanding particular skills, management is only following sound business practices; hire a specialist for a specialized job and the accountants can forget about the red ink.

If Mr. Moesel wants a job in aviation, he must show some initiative. I suggest that you direct his attention to the employment opportunities offered in the "Searchlight Section" of AVIATION WEEK. Let him spend 30 years in a "chicken-one-day-feathers-the-next" industry, and he will learn that his prejudices are erroneous and

THIS IS FOR YOU ... IF YOU HAVE AN AC GENERATOR COOLING PROBLEM!

SPECIFICATIONS

208/120 Volts, 0.75 Power Factor, Y-connected, 400 CPS

Type No.	Rating KVA	Rated Cooling Air Pressure "H_2O	Rated Cooling Air lb./min.	Diam. in.	Speed RPM	Approx. Weight lbs.	Flange and Drive Spline
*28E16-1	20	6	11	8.25	6000	60	AND10266 XVI-A
*28E17-1	30	5	13	8.25	6000	69	AND10266 XVI-A
*28E14-1	40	5	14.5	9.25	6000	83	AND10266 XVI-A
*28E15-1	60	6	16	9.25	6000	100	AND10266 XVI-A
28E19-1	10	6	8.4	6.5	8000	31	AND10262 XII-A
28E19-3	10	6	8.4	6.5	8000	32	New 9" Flange
28E20-1	20	6	8.5	6.5	8000	45	AND10262 XII-A
28E20-3	20	6	8.5	6.5	8000	46	New 9" Flange
28E21-1	30	10	12.4	6.5	8000	60	AND10262 XII-A
28E21-3	30	10	12.4	6.5	8000	61	New 9" Flange
**28E10-1	9	6	8.6	6.5	8000	39.5	AND10262 XII-A

*These generators include integral fan permitting full load continuously up to 80°C at sea level with no additional cooling.

**This generator incorporates a DC output of 30 volts, 50 amps capacity in addition to the AC output.

All generators have been designed to MIL-G-6099 and MS-33542 which specifies cooling air of 120°C at sea level, 40°C at 50,000 ft., and —12°C at 65,000 ft., and will deliver full rated load under these conditions.

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HIGH-TEMPERATURE AC GENERATORS

meet military class C air-cooled specifications ... offer maximum performance at minimum size and weight... range from 9 KVA to 60 KVA

These generators are designed as part of complete Red Bank high-temperature AC generating systems that also include mag amp voltage regulators and system protection components. For full details, write Red Bank Division, Bendix Aviation Corporation, Eatontown, New Jersey.

West Coast Sales and Service: 117 E. Providencia Ave., Burbank, Calif.
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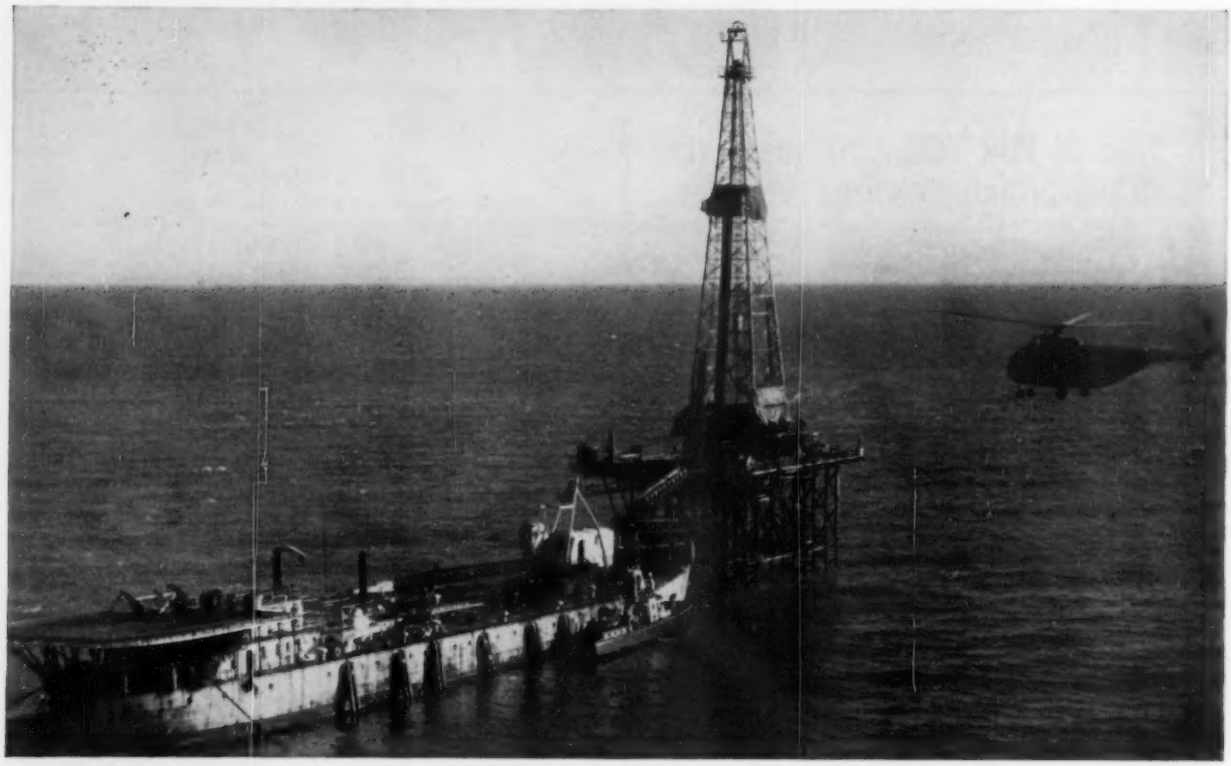
Red Bank DIVISION — Bendix AVIATION CORPORATION



OFFSHORE AIRBUS—Going to and from work in Sikorsky helicopters is now routine for crews drilling oil wells offshore. In the Gulf of Mexico, helicopters have made as many as 2000 scheduled flights a month for one company alone. They have introduced new operating methods offshore. Here, an S-55 nears a tender's landing platform.

AROUND THE WORLD WITH SIKORSKY HELICOPTERS

NEWFOUNDLAND PATROL—This commercial Sikorsky S-55 now regularly polices Newfoundland's extensive coastal waters, on duty with the Fisheries Department of Canada. Speed, versatility and rugged stamina of the big Sikorsky make it an ideal vehicle, especially for work in remote areas where surface travel is difficult.

NORTH SEA RESCUE—In mid-January, 16 crewmen from a Norwegian freighter, grounded on the coast of Holland, were rescued by the Royal Dutch Navy helicopter shown above with one of the rescued men. The big Sikorsky, an S-55 Navy version from a Dutch aircraft carrier, made five quick flights to carry the men to the beach.

TREE-TOP MINING PROSPECTOR—Modern electronics and Sikorsky's S-55 commercial helicopter are combined in a new aerial prospecting technique developed by Aero Service Corporation, Philadelphia. Data on underground mineral-bearing formations are disclosed by magnetometer, flown over an area at tree-top height. Such geophysical surveys are far faster, reveal more and cost less than slow ground studies.

HELICOPTER HISTORY:

America's first world helicopter record—set by Sikorsky's VS-300

MAY 6, 1941—Flying his historic VS-300, Igor Sikorsky, nearly 14 years ago, remained in the air for 1 hour 32 minutes 26 seconds, to bring America her first world helicopter record.

The VS-300 was first of the many Sikorsky achievements in advancing helicopter design, development and production.

SIKORSKY AIRCRAFT

BRIDGEPORT, CONNECTICUT

One of the Divisions of United Aircraft Corporation

not at all typical of the industry at large.

I am proud of the industry to which I have devoted most of my lifetime, and I constantly marvel at the progress that has been made in spite of those who, through ignorance or contrary personal ambitions, scream tirades against an industry that was born of American ingenuity and which has grown because of American initiative, tenacity, and efficiency.

Apartment houses, indeed! Tell Mr. Moesel to stick to his over-sized Erector sets!

S. C. Timson.
8814 Second Ave.
Inglewood 4, Calif.

Engineer Shortage

At last you have printed a letter that gets down to facts.

I am referring to the letter of William H. Moesel.

For a long time we have been hearing this sickening lament about a shortage of engineers. What absolute drivel!

Beside the great number of engineers being wanted, like Mr. Moesel points out, there are also a number who, like myself, with 15 years experience, have found it more than we can stomach and wouldn't touch it again with a 10-ft. pole.

Yes, a poll of ex-aircraft engineers would be interesting. I can name 12 in my immediate circle of acquaintances. But as Mr. Moesel stated, their reasons for leaving the aircraft industry would not make very nice reading.

Another thing. Just how many of the "help wanted" ads published in your magazine do you think are sincere? Not too many of them, I can assure you.

Three years ago I was killing time—I haven't the guts to say "working"—for an outfit (name on request) that was advertising for aircraft engineers in almost every issue of your periodical.

To all intents and purposes the department had been disbanded three months before. There were four of us left, reading magazines and "fronting" for the company. The week I resigned there was a double-page ad in your magazine calling for engineers. To this day not an engineer has been hired.

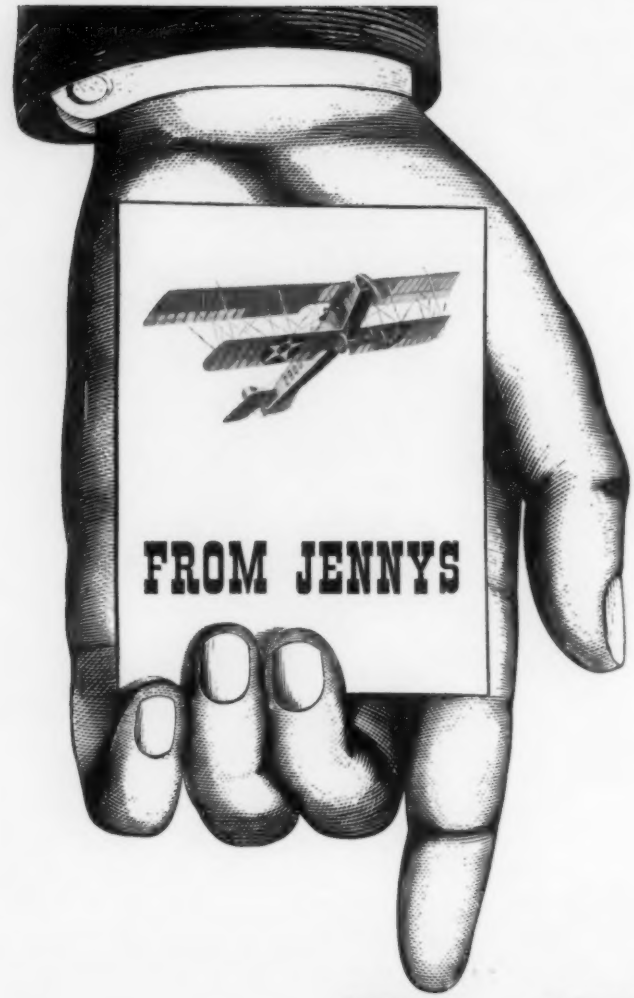
Maybe the gross mismanagement is the reason for these insincerities and deliberate misstatements. Too bad, because an airplane is such an interesting product.

S. P. Hughes
119 E. Goodwin St.,
Prescott, Ariz.

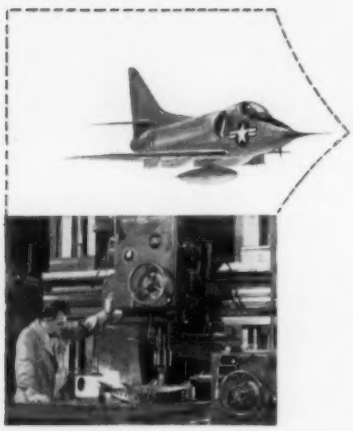
No Engineer Shortage?

I have read with great interest Mr. Moesel's letter on the "engineer shortage" (AW Mar. 7, p. 37). I too have been amused if not angry at the "crying in the wilderness" by certain aircraft executives about a shortage of engineers.

I recently left a position as an engineer with a large Long Island avionics manufacturer. I can testify to the waste of engineering manpower by my own experience. For example, in order to obtain a paper from the company library, it was necessary to walk the entire length of the plant (¾ mile) be-



TO JETS



Axelson's service to the aircraft industry extends over a period of many years, and we have seen to it that facilities have kept pace with this fast moving industry. Two modern plants are staffed with competent engineers and master craftsmen who provide rapid and accurate production of many aircraft components including landing gear shock struts, gears, geared mechanisms, segments, spars, braces and other plane structural parts. We invite your personal inspection of these facilities. Should time or distance not permit, your request will bring Facilities Booklet 5037, which gives in pictures the inside story of Axelson equipment and capabilities.

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Convair's F-102A, newly modified interceptor, is a most recent addition to Air Force Supersonic Fleet.

High Altitude Fuel Flow Failures Eliminated In Convair F-102A!

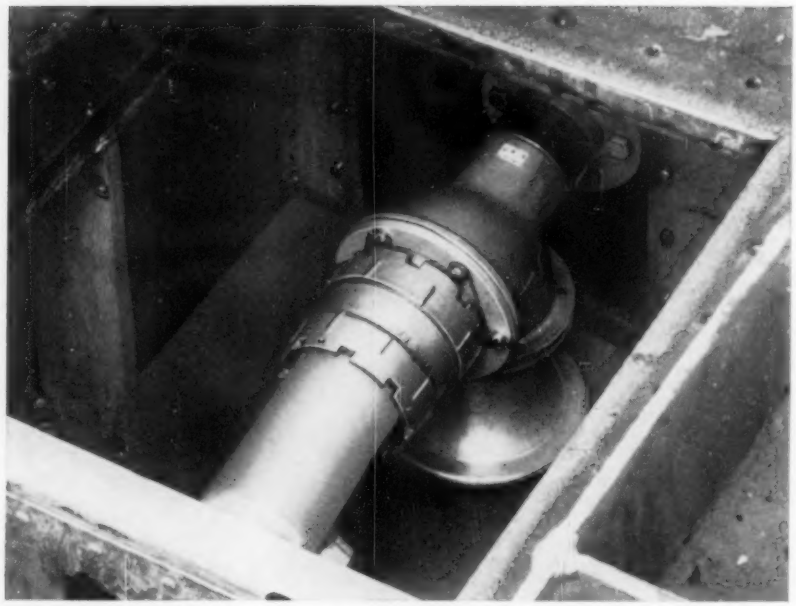
Accessory Products Corp. *develops emergency by-pass valve for fuel booster pump failures.*

See next page ➧

APCO High Flow Fuel Valves Overcome Danger Of Choked Fuel Supply Should Booster Pump Fail

In the event of a fuel booster pump failure in the Convair F-102A, the engine pumps must take over the full load. If, however, the fuel were to be sucked through the dead booster pump, the result would be an excessive pressure loss — too great to sustain engine operation at high altitudes.

▸To meet this problem, Convair engineers asked APCO to develop a by-pass valve that would enable uninterrupted flight even though the booster pump failed. The result is a "T" flapper valve, light in weight with a high fuel flow capacity to meet the high altitude requirements. The actual pressure loss is ten times less than if the fuel were to be drawn through the dead booster pump — another example of APCO design ingenuity.



View looking into fuel tank showing location of "T" flapper valve. Note the intake ports have been spun for greater weight saving.

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Convair Engineer Credits APCO With Unusual Design Ability

"The 'T' flapper valve for the F-102A is a good example of the exceptional design ability of the APCO engineers," says C. S. Brandt, Convair propulsion design specialist. "The valve is light and compact, yet has a high fuel flow capacity — required for high altitudes.

"We can usually depend on APCO to do more than just meet the specifications. They have an excellent understanding of our problems."

"We can usually depend on APCO to do more than just meet the specifications," says Convair's C. S. Brandt.

Meet Everett Badger APCO Fuel System Specialist

APCO's fuel system specialist, E. V. Badger.

Typical of the outstanding young men making history in the industry is APCO's fuel system specialist, Everett Badger. Only 35 years old, yet he has already gained national recognition during his 11 years experience in aviation parts and equipment. After graduating from Rice Institute, Badger spent some time with the Air Force in Alaska making cold weather tests. Currently, he is group head on a special APCO fuel equipment development program.

"Unusual Willingness And Know-How Displayed By APCO" Says Convair Engineer!

"We like APCO's willingness to make just a few parts," says Convair's Andy Minella.

"One thing in particular we like about APCO," says Andy Minella, Senior Design Engineer at Convair, "is their willingness to make a few parts for us without a promise of a big production run.

"At Convair, San Diego, we need good understanding and communication between our engineers and vendors. Because our location is not on the beaten path of the rest of the industry, much time can be lost if a supplier does not come up with the answers the first time. APCO's performance is unusually good. Also, their constant concern with the weight problems has resulted in some engineering firsts. For example, they have made unusual use of spun parts and thin wall castings. Of course, this means greater weight saving."

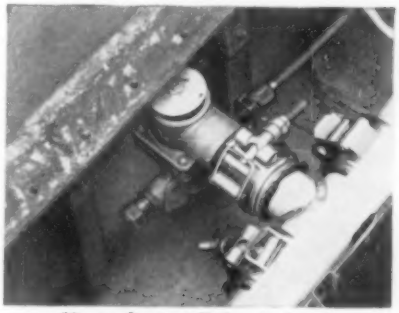
Single point fueling system for Convair's F-102A saves precious minutes in fueling time.

Time-Saving Single Point Fueling Of Convair Interceptor Made Possible By APCO Vent Valve

During attack, an interceptor out of gas is as useless as an AA without ammo. Single point fueling system for F-102A saves precious minutes in fueling time.

The integral fuel tanks in the delta winged F-102A can easily be damaged by excessive fuel or air pressure. During the single point fueling operation, a small internal vent valve in each tank is required (1) to prevent over-pressurization in case the refueling hose shut-off fails, (2) to adjust for increased air pressure as the tanks are being filled. This small, simple but most vital vent valve *must* be dependable at all times. A failure in this valve could result in a plane being grounded for many hours. APCO was chosen to design and produce this important valve because of its exceptional engineering ability and past performance.

APCO's double duty vent valve



Vent valve installed in fuel tank

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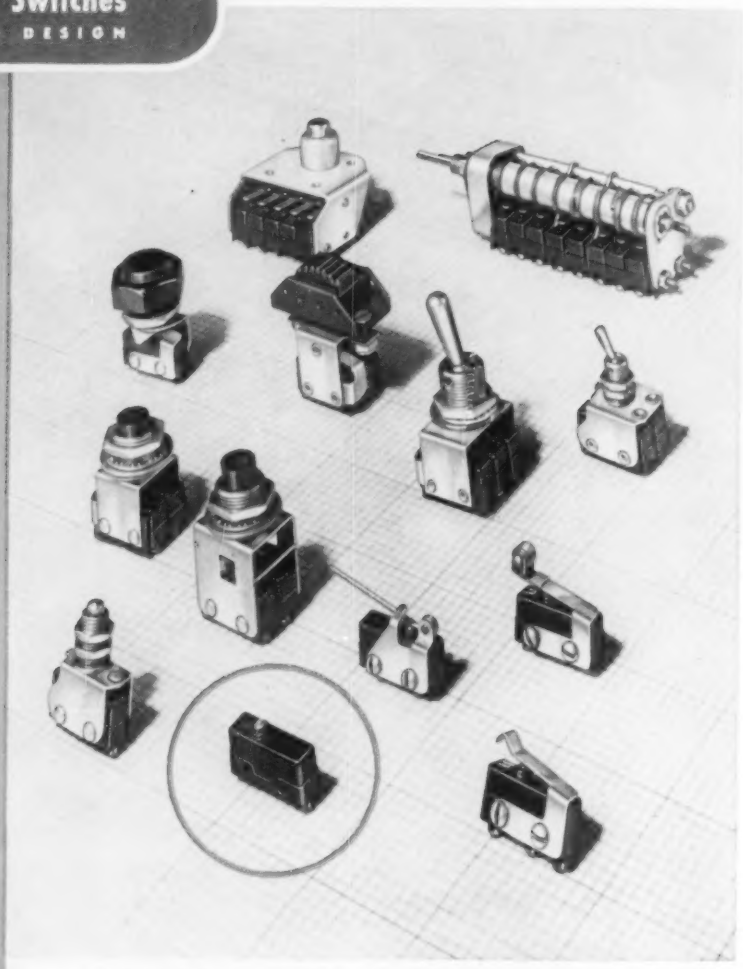
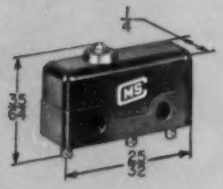


Here's the small switch—



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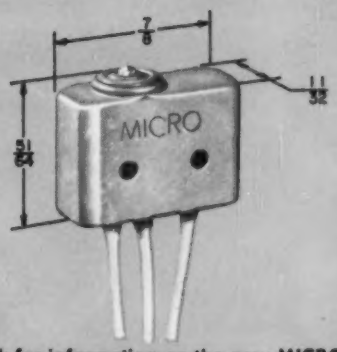

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• Ability of MICRO SWITCH engineering to design and develop this Subminiature switch has been a major contribution to many phases of aircraft design.

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MICRO SWITCH provides a complete line of extremely reliable, small-size, high-capacity, snap-action precision switches and mercury switches. Available in a wide variety of sizes, shapes, weights, actuators and electrical characteristics. For all types of electrical controls.

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cause the library was too busy to send a $35-a-week clerk on a bicycle.

I spent over 25% of my time searching the stock room and receiving department for parts because the "expediters" were too busy to do it. This situation was true throughout the plant. I knew of engineers who spent 100% of their time doing such things.

I am now with a research group in the Midwest and I would not return to engineering for any salary. Let me close by agreeing with Mr. Moesel and "Unsigned" in saying: Engineering shortage—"Nuts"!

EX-ENGINEER

Re: William H. Moesel's letter, why don't you conduct a poll as he suggested and inquire about this so-called "Engineer Shortage." We of the aircraft industry really have a lot to tell! It will boost your circulation at least 10%.

Try it, let's open the eyes of these antiquated aircraft makers. . . .

EX-AIRCRAFT ENGINEER

NACA As Employer

Just a note after reading your Mar. 28 issue of AVIATION WEEK ["Scientist Shortage Threatens Defense"].

I wish to call your attention to statements made on two pages (24 & 37) concerning NACA and pay.

On page 24, the speaker didn't know how right he was about engineers leaving NACA for industry. Check on just how many former NACA engineers are now working for Lockheed at the Georgia branch, just as one case.

► **Wage Scales**—On page 37, under Pay and Advancement, there's more to the story. Engineers working under Civil Service Regulations wage scales are bound.

With all the high wages in industry, at the present time, it's rather foolish for graduates to think of working for NACA. But, if they are willing to take the cut in pay for a couple of years, they can get the best practical training obtainable, then industry will offer them about twice the Civil Service pay.

As to having "red tape" removed, this writer would like to know where.

A basic research program presented to those responsible to the engineer in charge nearly has to present the results before he is permitted to conduct the program. This is research? In any number of cases, a program is started within the division, without knowledge of the front office, proving that they are on the right track, then the front office is let in on the program.

From this writing it might be thought that this writer is bitter but he is not. He just thinks that it could be run on a better basis out from under Civil Service pay regulations and brought to the attention of those who allot money for NACA that they should not expect a dollar's worth of results for every dollar put in.

► **Job Satisfaction**—It is right when they say that the people of NACA are devoted to their work with little publicity on the outside. Many things are announced to the public by industry which NACA has a big part in developing. The only satisfaction obtained is the person or person's own feeling, knowing that he or they had a big part in bringing about the results.

Then there are times of great discontent,

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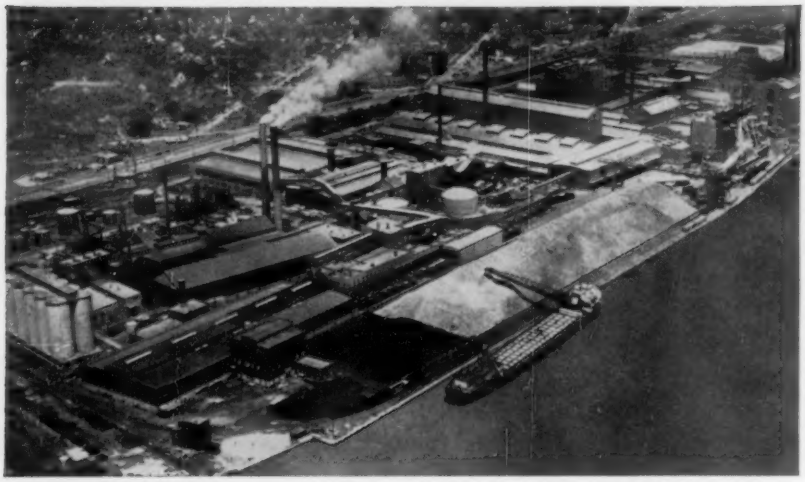

Wyandotte's South Plant in Wyandotte, Mich., covers fifty-two acres; produces scores of basic chemicals for industry. Here, and at Wyandotte's newest plant in Los Nietos, Calif., specialized products for the aircraft industry are manufactured.

	YOUR PROBLEM	ANSWER	DESCRIPTION
1	Aluminum cleaning	Altrex*	All-purpose, non-etching soak-tank cleaner; removes marking inks and soil.
2	Deoxidizing aluminum prior to spot welding	2487	Room-temperature deoxidizer: reduces contact resistance of aluminum alloys.
3	Magnesium cleaning	W.L.G.*	Heavy-duty soak cleaner for magnesium, steel, copper, and brass.
4	Removing heat-treat scale from stainless steel; brightening heat-treated aluminum	MF Acid	Replaces dangerous hydrofluoric acid; easier and safer to handle and use; less corrosive.
5	Paint-booth coating	Hedral	Protective coating. Cuts labor costs, simplifies booth upkeep. Brush or spray on.
6	Waterwash paint-booth compound	Flote†	Very small amounts required; kills zinc chromate primer, floats air-dry lacquers.
7	Electrocleaning	F.S.*	Heavy-duty electrocleaner for cleaning steel before plating. Exceptional detergency.
8	Barrel finishing	Burnek	Add to water in barrel finishing for brighter metal finishes. Removes light tarnish.
9	Floor absorbent (anti-slip)	Zorball	An all-purpose floor absorbent; makes floors skidproof, safe at lowest use-cost.

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NAME WITHHELD

AGCA Problems

The automatic ground control approach referred to by Dunstan Graham and Richard Lathrop (AW Filter Center, Feb. 21, p. 72) do exist in the experimental AGCA equipment which is being tested at Wright Air Development Center.

However, these problems have been eliminated in the production AGCA equipment (sponsored by Rome Air Development Center) which is now in pilot-run production at Gilfillan Bros. Inc. Models of this production equipment have been functioning at the Gilfillan Bros. airfield at Fontana, Calif., for more than a year with no evidence of cross talk between the azimuth and elevation control signals; this is primarily due to the use of a different telemetering system.

In addition, the new equipment eliminates the rate signal in the approach area in which radar data may contain significant noise components. The AGCA computing circuits have been optimized such that radar noise is rejected throughout the approach area. These innovations combine to assure smooth and accurate AGCA approaches.

B. CUTLER
Project Engineer
Gilfillan Brothers, Inc.
1815 Venice Boulevard
Los Angeles 6, Calif.

8-Hr. Work Limit

In reading the Jan. 31 AVIATION WEEK, I find that the ALPA and one of its members do not agree, that is Pilot Robson.

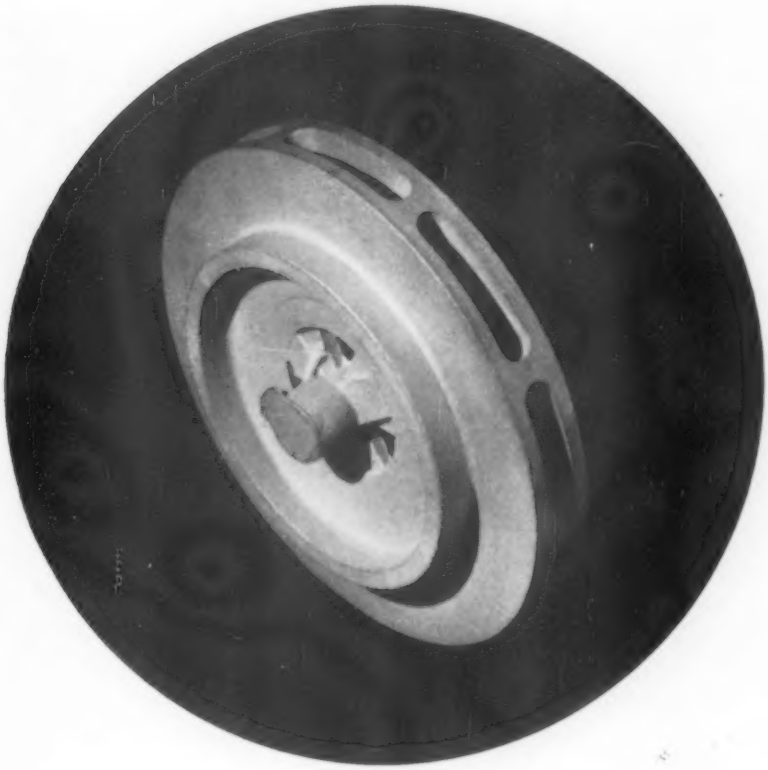
Pilot Robson says that a man will get tired from working and I agree; ALPA also took the stand and forced a strike against American Airlines because they didn't agree with the CAB that an extra 30 min. was a safe procedure.

Then I find in the same issue that they aren't tired anymore and that it's perfectly safe to operate an aircraft nonstop over 8 hours, providing they have more money in their pocket; seems a bit silly to think that extra money will remove the fatigue and thereby make the flight safe.

Actually the strike was against the CAB and not American Airlines; therefore I believe it's about time ALPA stopped trying to run the aviation and airline industry and just operate as it is supposed to—that is as the bargaining agent for pilots, not the operating agent for all airlines. In other words I believe that the CAB should be in charge and control aviation and airline procedure.

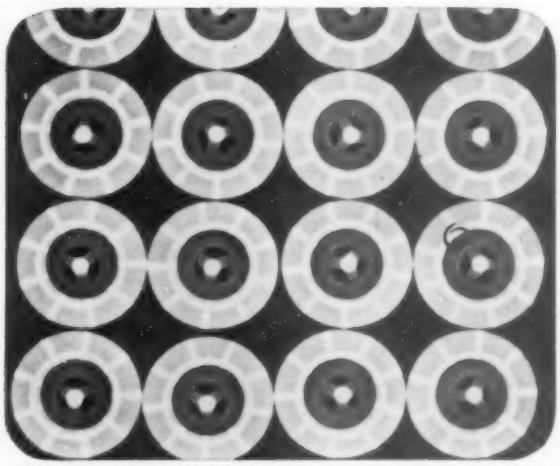
Would like to see Pilot Robson's article stay closer to facts and not so much imagination—domestic operations of 14 to 16 hrs. per day on duty and in flight.

A. W. ZIBELL
4111 Beresford
San Mateo, Calif.



SPINS LIKE "BLAZES"—

so Radiography checks each one



Radiograph of oil scavenger rotor in variable displacement pump for aircraft hydraulic systems.

"BLAZES" is not the word—but suggests the maker's shorter expression for the rate at which this rotor spins. Fact is, rpms are so high that the soundness of the casting is important in terms of safety as well as serviceability.

So radiography goes to work and plays its unique part. With no damage to the product, radiography looks inside the part and checks each rotor's structure. Only flawless parts will meet the strict requirements of service.

Proving soundness with x-rays has become common practice with more and more suppliers of quality castings. They know it helps build reputations for delivering only good work.

If you'd like details on how radiography can improve your operations, get in touch with your x-ray dealer—or write us for a free copy of "Radiography as a Foundry Tool."

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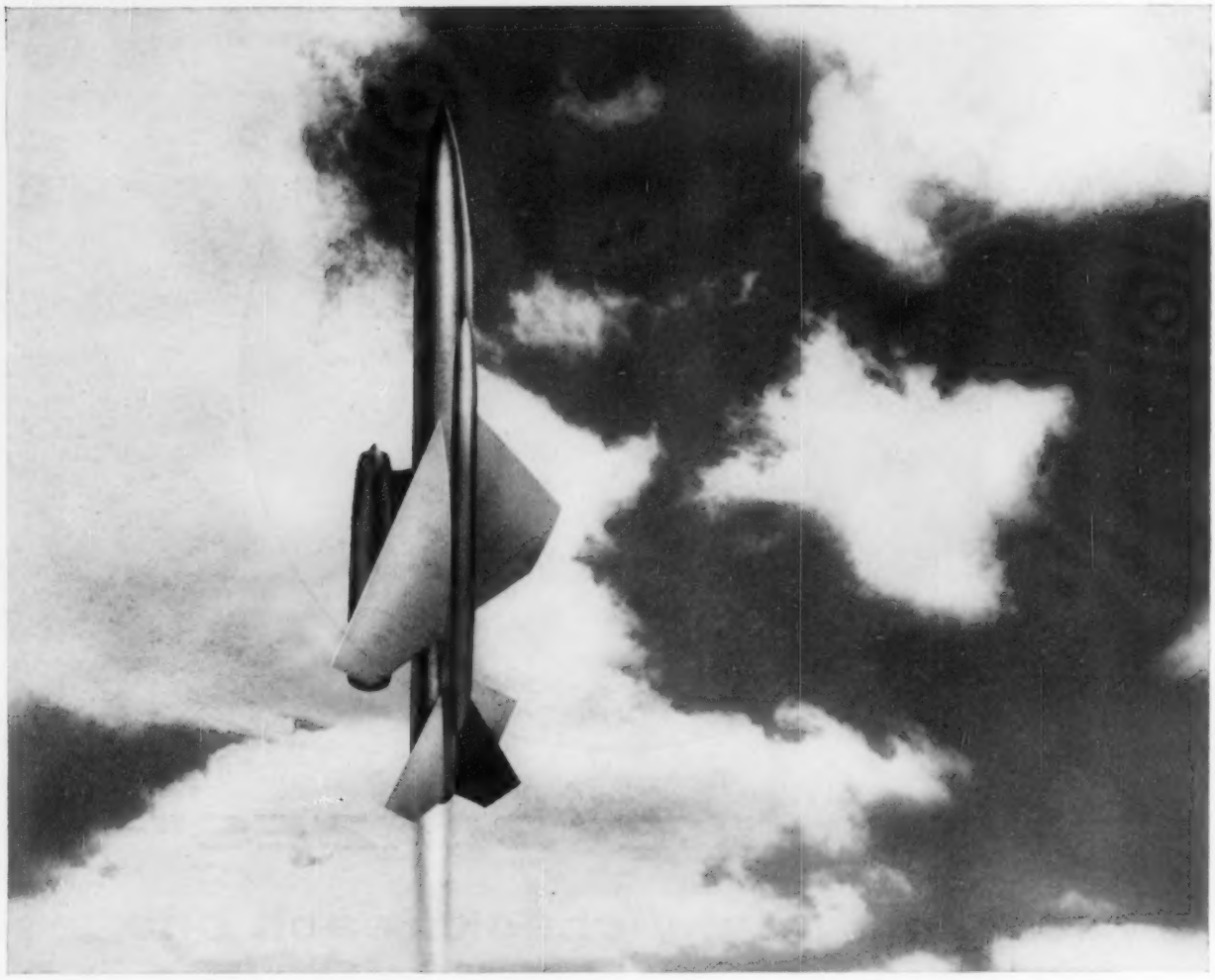


Spearhead of a new Air Force defense weapons system

One of the weapons taking an increasingly prominent position in American defense plans is the guided missile.

Like any other category of weapons, guided missiles vary in design, in complexity, and in performance. Some missiles are destined for short-range efforts. In contrast, the F-99 pilotless interceptor now being developed by Boeing in co-operation with the Air Force is a longer-range missile designed to strike high-speed enemy bombers over areas away from vital targets. While the missile is operating at supersonic speed, its flight path will be controlled by electronic devices that guide the missile into position to destroy the target aircraft.

As a part of the F-99 Bomarc missile program, Boeing engineers are developing an entirely new weapons system for air defense. It includes bases, communications, logistics and maintenance, in addition to the missile itself. Boeing's experience in the missile field goes back more than eight years. Today the company's enlarged Pilotless Aircraft Division is utilizing a steadily growing portion of Boeing's vast research and design facilities, and engineering staff.

Working of necessity behind a curtain of secrecy, Boeing missile engineers are carrying on extensive research and development in the widely diversified engineering fields required—among them rocket and ram-jet propulsion, supersonic aerodynamics and electronic guidance and control.

The development of the Bomarc system has behind it the huge engineering, research and production resources of Boeing—resources of sufficient breadth and depth to have created the jet age's outstanding bombers, the B-47 and B-52, and America's first jet transport, the Boeing 707.

Young men: You'll acquire "know how" as an airman in the United States Air Force. Opportunities for top technical schooling, world travel and a responsible position on the nation's defense team.

BOEING

Line-of-Sight 'Barrier' Latest to Fall

By Philip J. Klass

Details on the successful breaking of the line-of-sight "barrier," which had been thought to limit VHF and UHF transmission distance, were revealed before the recent Institute of Radio Engineers national convention in New York.

The new techniques already are being applied to military communications in the Arctic and to the operation of remote air defense radar stations, despite the fact that the experts admit that they do not fully understand the mechanics of beyond-the-horizon (BTH) propagation in the lower atmosphere (tropospheric); some are still in sharp disagreement over the explanation for BTH upper-atmosphere propagation (ionospheric).

IRE speakers described the following accomplishments in BTH transmission:

• **USAF teletype network** operating over 1,200-mi. ionospheric links which show 99% reliability at times when HF communications are blacked out.

• **Voice transmission** (trophospheric) at 400 mc. over distances of 375 mi.

• **TV picture and voice transmission** at 5,000 mc. (with 15-20 mc. bandwidth) for distances of nearly 200 mi. (By contrast, present TV microwave networks employing line-of-sight transmission normally have their towers spaced an average of only 30 mi. apart.)

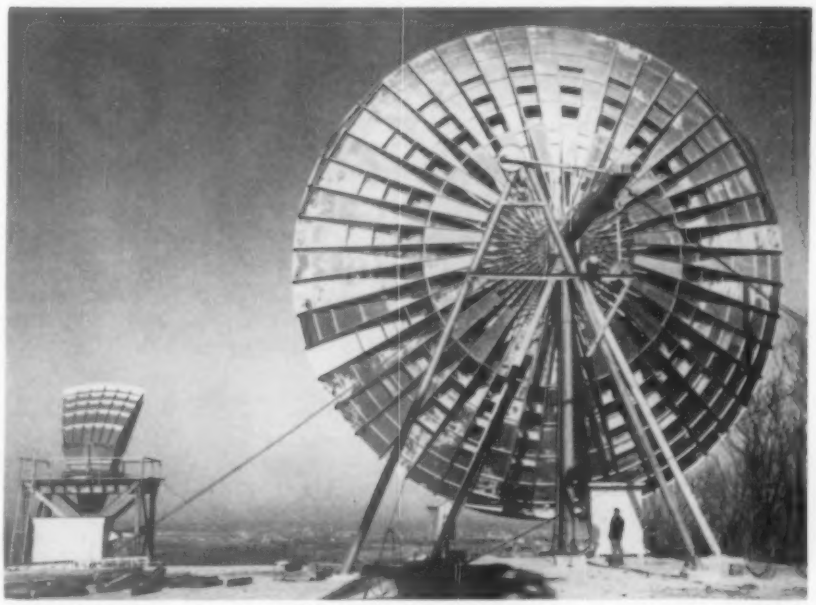
▶ **Other Interesting Papers**—Some of the other IRE papers, which described new developments of interest to persons in the avionics field, included:

• **Transistorized computer circuits,** developed by Philco, which employ novel techniques to simplify overall circuit design, cut number of components required, and slash power consumption.

• **An 1,800-channel VHF-UHF** communications set, developed by Collins Radio, which employs novel reflex techniques that make it possible to cut number of tubes used by 50% and reduce number of tuned circuits by 25%.

• **Precision nav-aid system,** developed by Jacobs Instrument Co., which employs a CW phase- comparison technique that reportedly enables aircraft to establish their position to within 0.5 ft.

• **Typotron,** a character-display type of cathode ray tube developed by Hughes Aircraft, which resembles the Convair Charactron (AW Nov. 15, 1954, p. 77), with the added feature of built-in storage of the display until erasure is desired.



HUGE ANTENNA can pick up UHF and microwave signals from far beyond line-of-sight distance. Antenna at left is used for conventional microwave transmissions.

A new ceramic triode tube designed for high-temperature, airborne CW or pulsed power use up to 4,000 mc., was unveiled by General Electric during the convention, using a closed-loop TV from their Schenectady tube plant. The new GL-6442, reportedly being used in the new Collins Tacan and ARC-52 receivers, is rated at 2-kw. peak output at 3,500 mc., with a 0.001 duty factor. Tube can be operated as a Class C RF power amplifier at 2,500 mc., with 8-w. plate dissipation, GE says.

IRE convention attendance totaled approximately 41,000, slightly over last year's figure. More than 700 exhibitors displayed their wares, overflowing the 4-acre Kingsbridge Armory and requiring the use of a nearby indoor skating rink for 100 exhibits.

Beyond the Horizon

Recent findings have punctured earlier theories as to the cause and nature of tropospheric beyond-the-horizon transmission. Although these tests leave the experts up in the air "theory-wise," they have established the feasi-

Behind The 'Barrier'

Until recently, VHF and higher-frequency radio signals appeared to stop at the horizon. Unlike lower-frequency waves, they neither followed the earth's surface, nor did they appear to bounce back from the ionosphere with any apparent degree of consistency.

During the past several years, however, scientists have taken another look at the whole matter, spurred by the military need for reliable communications in and to the polar regions (where HF frequently is blacked out by magnetic disturbances) and by the need for some means to pipe information from inaccessible radar stations without resorting to expensive landlines or microwave networks. Added incentive at Bell Telephone Labs was to learn why microwaves frequently overshot their expected range in microwave networks.

Research has been greatly aided by new high-power transmitting tubes and improved techniques for fabricating extremely large (high-gain) antennas and more sensitive receivers. Importance of such factors is underlined by the fact that signal attenuation beyond the horizon is 10,000 to 100,000 times greater (80-100 db.) than that over line-of-sight distances.

bility of BTH transmission at UHF frequencies at distances of at least 400 mi.

The phenomenon shows some of the characteristics of atmospheric refraction, but there appear to be other factors involved. This has caused the earlier-used term of "scatter" to be abandoned in some quarters for the term "forward scatter." The phenomenon is sometimes likened to a powerful searchlight aimed at the sky, some of whose light is reflected to the ground by the atmosphere.

▶ **Old Ideas Scuttled**—Contrary to earlier views on troposphoric propagation, Kenneth Bullington of Bell Telephone Labs told the IRE that:

• **Useful bandwidths** can be achieved in BTH transmission which are at least 10% of those obtained in line-of-sight (LOS) transmission, using the same size antenna.

• **Antenna gains of 40 db.** can be achieved in BTH transmission, with a loss of only 1-2 db. from that obtained with LOS. Not too long ago scientists believed that maximum antenna gain was limited to 10-15 db. under BTH conditions because of phase shift, Bullington says.

A movie of experimental transmissions of commercial TV video and sound over a distance of 188 mi. was shown by Bell Labs' W. H. Tidd. (The video signal was frequency-modulated on a 5,000-mc. carrier.) Picture quality was excellent, with momentary fades occurring every 15-20 seconds. These were noticeable but so brief as not to be unduly bothersome to the viewer.

Another example of even longer-range tropospheric propagation was described and demonstrated by Walter Morrow of MIT's Lincoln Labs. In a joint Lincoln-Bell Labs investigation, a 400-mc. voice signal was successfully transmitted over a 375-mi. path with relatively little fading or interference. A 28-ft.-dia. antenna and 5-kw. transmitter were used, at least 1,000 times the power employed in present transcontinental line-of-sight microwave networks.

Tropospheric propagation, and to some extent ionospheric, is subject to fast fading, caused by multi-path transmission, as well as slower fading over a period of hours or days, which is independent of frequency. One possible solution to this problem is the use of several antenna locations (diversity antennas).

▶ **Tropospheric vs. Ionospheric**—There are interesting differences between the BTH characteristics of tropospheric and ionospheric propagation, Bullington pointed out.

For instance, attenuation losses are essentially independent of radio frequency when the waves are "scattered" from the troposphere. However, attenuation goes up sharply with frequency when ionospheric propagation is involved.

For instance, in tropospheric propagation, 100 mi. beyond LOS range a 100-mc. signal is down approximately 50 db. over free-space attenuation. The frequency can be increased 10-fold to 1,000 mc., with less than a 2:1 increase in losses (55 db.), according to Bullington's figures. By contrast, ionospheric attenuation is more than tripled over free-space values when the frequency is raised from 35 mc. to 50

Tropospheric Propagation Booklet

New brochure prepared by National Bureau of Standards describes tropospheric propagation experiments, theories, and facilities of NBS's Central Radio Propagation Lab atop Cheyenne Mountain in Colorado. The 39-page publication, authored by A. P. Barsis, J. W. Herbstreit, and K. O. Hornberg, is identified as NBS Circular 554.

It is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 30 cents per copy.

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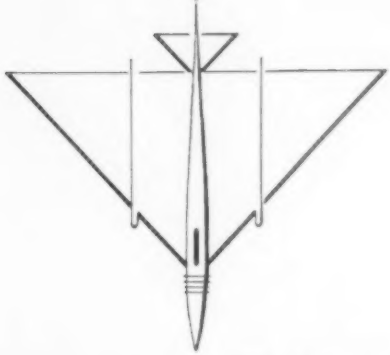

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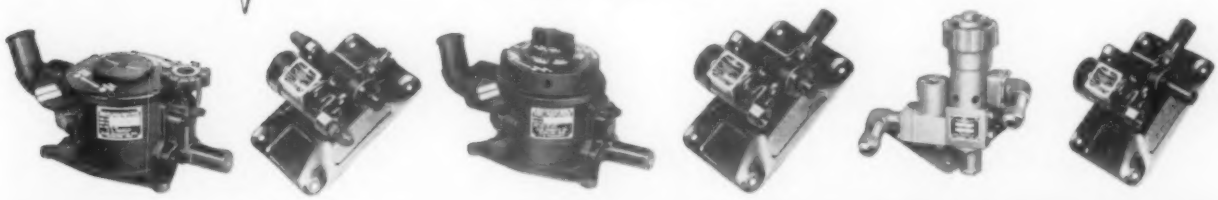

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mc. (85 db. to 95 db.).

One theory advanced to explain the frequency sensitivity of ionospheric propagation is that the ionosphere layers are not solid, but resemble a mesh (chicken wire). If the wavelength of the radio signal is large compared to the holes, the mesh acts like a solid layer and reflects the signal. At higher frequencies, where the wavelength approaches or becomes smaller than the mesh holes, waves pass on through without being reflected.

▶ **Experts Disagree**—The National Bureau of Standards and Collins Radio have conducted experimental 1,200-mi. transmissions of an unmodulated 50-mc. carrier between Cedar Rapids, Iowa, and Sterling, W. Va., using ionospheric propagation. These tests indicate the following characteristics for BTH ionospheric transmission, NBS's Dana Bailey reported:

- **Strongest signal reception** occurs in the summer.
- **Signal strength in December** during mid-day is nearly as high as peak signal during the summer, but falls off sharply with darkness.
- **Signal strength** in the Arctic during the summer is much higher than at lower latitudes, and does not drop off as sharply.
- **Strong enhancement** of a 50-mc. signal has been observed in the Arctic during intense magnetic activity which blacks out normal HF radio signals.

Bailey's conclusion is that ionospheric BTH propagation appears to show a dependence upon solar activity, possibly due to ionization resulting directly or indirectly from the sun's rays.

Dr. Oswald Villard, of Stanford University, took sharp issue with this explanation. Villard's theory is that ionization caused by meteor trails plays a dominant role in ionospheric reflection. He presented limited data which indicates that propagation is best at times of intense meteor showers.

▶ **AF Puts to Use**—The Air Force presently is operating a three-hop teletype network (four-channel) between Limestone, Me., and Thule AFB in Greenland, employing BTH ionospheric transmission, Bailey reported.

The network operates across the auroral zone, where ordinary HF communications are usable only 60-70% of the time. By contrast, the new BTH ionospheric transmissions have demonstrated a reliability considerably better than 99% over the two northern links, and 91-92% over the southern link (Limestone to Goosebay), Bailey reported.

The reason for the poorer showing in the southern link is that the hop distance is too short. BTH ionospheric transmission operates best at distance of 600 to 1,200 mi., Bailey said.

▶ **Propagation Characteristics** – NBS

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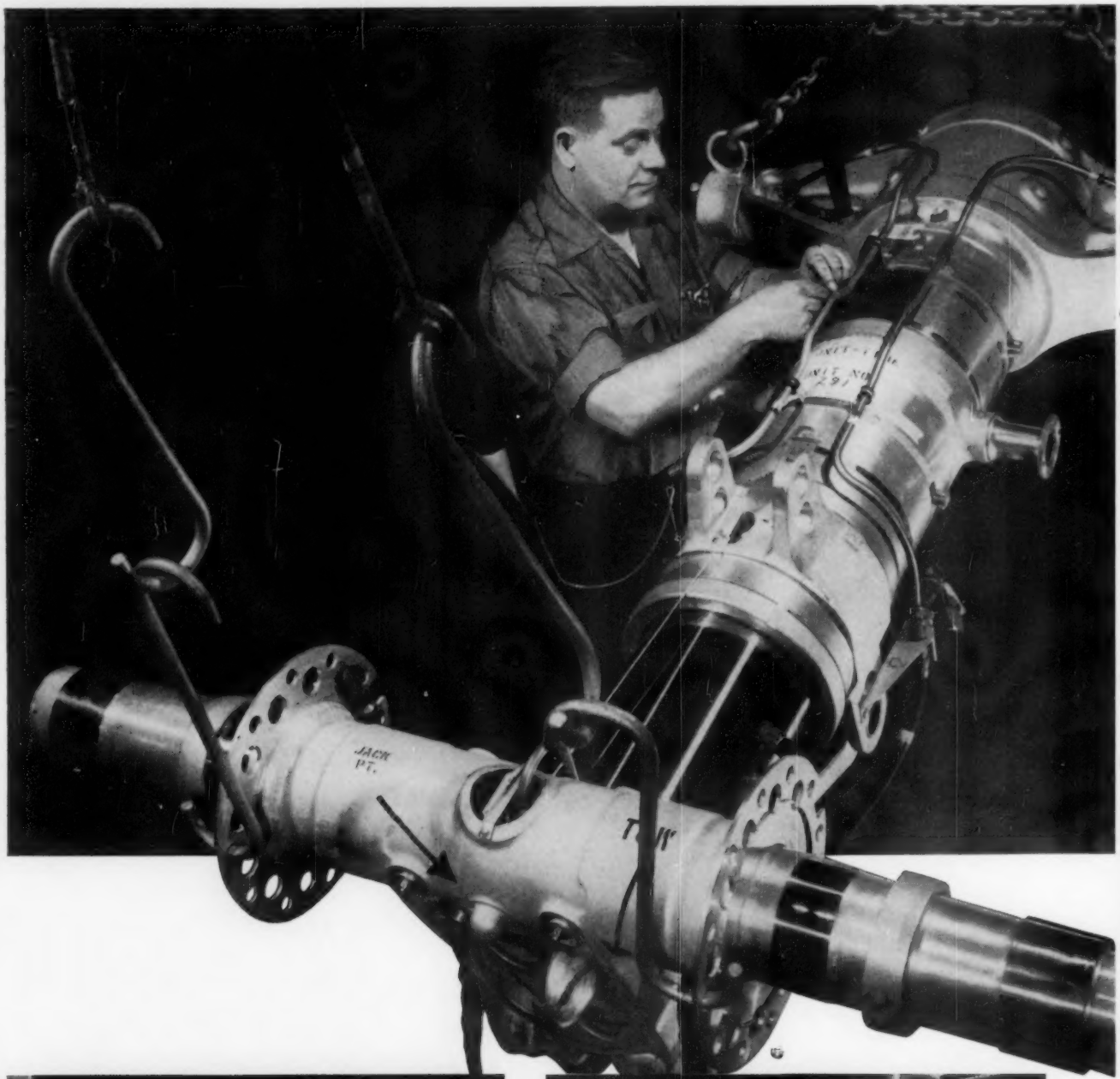
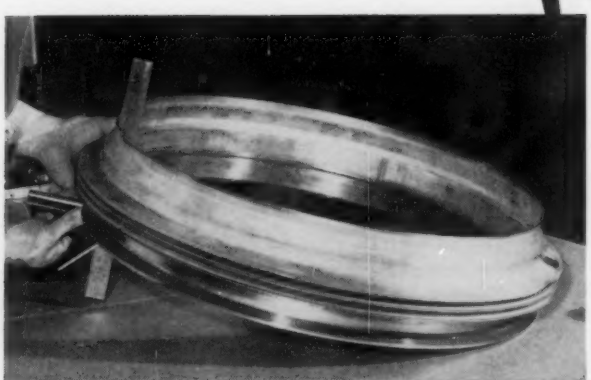
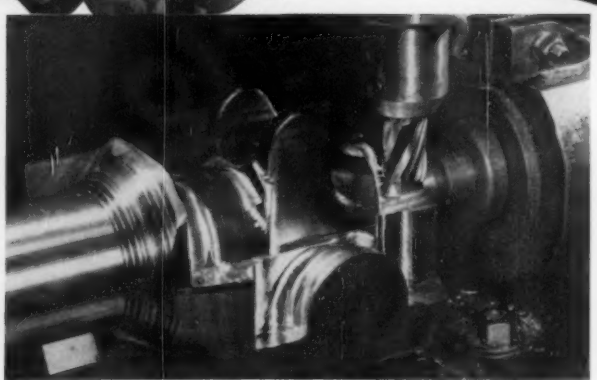




ENDURO STAINLESS STEEL DOES MANY AIRCRAFT JOBS EFFICIENTLY AND ECONOMICALLY. Here ENDURO is used in a bellows that goes between jet engine and exhaust tubes because of its heat-resistance and ability to expand and contract uniformly. There are other advantages—like increased structural strength without added weight, corrosion-resistance, high physical and chemical properties. Republic metallurgists will help you use ENDURO to best advantage.



TITANIUM AIRCRAFT PARTS CAN BE MACHINED like parts made from many other metals. This part is being hogged out of a titanium forging at Cleveland Pneumatic Tool Co. It will then be turned, drilled, reamed, ground, tapped, and threaded. Republic metallurgists recommend metals without prejudice. They will tell you whether titanium can be adapted to your product—will help you use it to advantage. Republic produces titanium and titanium alloys in hot and cold rolled bars, sheets, plates and billets.

Alloy Steels soften the shock of a 100-ton sock

And here's proof. Shock-absorbing landing gear struts and component parts, like the one illustrated, are made from alloy steels. The toughness of alloy steels helps these struts withstand the shock, impact, strain and vibration of up to 180 tons of aircraft hitting the runway at better than 100 miles per hour.

Alloy steels are exceptionally strong. Their high strength-to-weight ratio permits smaller sections to carry heavier loads with no sacrifice of strength or safety. They resist fatigue—maintain their great strength even at wide temperature extremes.

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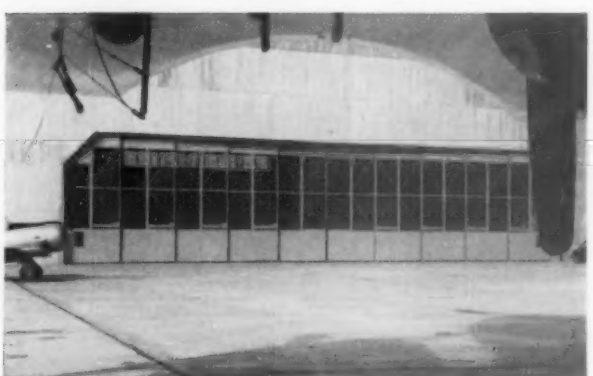

WHATEVER THE WING SPAN, TRUSCON CAN MAKE THE HANGAR DOOR TO ACCOMMODATE IT. Republic's Truscon Division knows the answers to big-door problems—has 28 years' experience in steel hangar door design and manufacture. Illustrated are the simplest and least expensive of all types, the motor-driven, Straight Slide Doors. Other door designs include Tail, Braced and Unbraced Canopy, Vertical Lift Canopy. Truscon engineers and field crews will help you plan and get the best door installation.

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Latest electronic controls guard quality at ALCOA

Both of Alcoa's forge shops are equipped with the ultrasonic inspection device pictured below. The operator, by tracking the forging under water with reflected ultrasonic waves, can instantly detect any discontinuity inside the forging. By probing far deeper than is possible with other nondestructive methods, it enables forging specialists to spot hidden flaws hitherto impossible to locate. Alcoa has been using ultrasonic inspection testing for 10 years and now has 30 units in operation.

This is just one of the advanced methods Alcoa uses to control the quality of forgings, extrusions, sheet and other products supplied to the aircraft industry. Alcoa pioneered many of these methods—and continues to do so. The Alcoa Cleveland Research Laboratory, for example, is experimenting with the first prototype xeroradiography unit—a device that yields an X-ray image in just 45 seconds.

Alcoa's advanced program of quality control—not duplicated elsewhere—provides the aircraft industry with the highest assurance of quality and resultant lower reject rates. Aluminum Company of America, 1800-D Alcoa Building, Mellon Square, Pittsburgh 19, Pennsylvania.

Your guide to aluminum value

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

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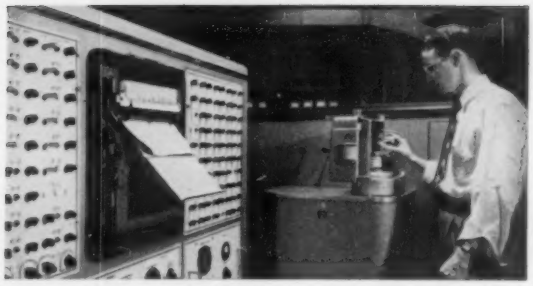
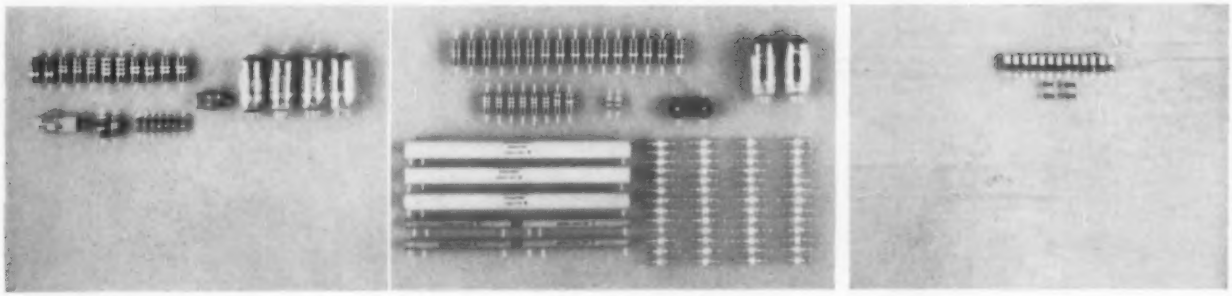


Quantometers, pioneered by Alcoa, have been installed in all Alcoa foundries, fabricating and smelting plants to insure the ultimate in quality control. Over eight million quality control determinations are made each year on these spectroscopic instruments. Of these, over 800,000 are metal composition determinations. A sample is taken from every ladle, an analysis is made by the quantometer and the results are sent back to the melting room before the aluminum is poured. No other company has made as extensive use of such analytical instrumentation.

Electric conductivity meters are used in Alcoa plants to test for proper heat treating. Any soft zones in the metal, resulting from incomplete quenching, are instantly detected by this device. Here, an Alcoa development engineer demonstrates the meter.



VACUUM-TUBE CIRCUIT (KIRCHHOFF ADDER, ASYNCHRONOUS TYPE)	DIODE AND VACUUM-TUBE CIRCUIT (LOGICAL ADDER, SYNCHRONOUS TYPE)	PHILCO TRANSISTOR CIRCUIT (LOGICAL ADDER, ASYNCHRONOUS TYPE)
POWER REQUIREMENTS 21.5 WATTS	POWER REQUIREMENTS 25.5 WATTS	POWER REQUIREMENTS 0.036 WATTS

TRANSISTORIZED COMPUTER CIRCUITS developed by Philco greatly reduce circuit complexity of conventional tube and tube-diode circuits, and slash number of components and power required. Circuits use only transistors and resistors.

studies suggest that signal intensity of BTH ionospheric transmission varies approximately as the ninth power of the angle of incidence between radio beam and the ionosphere, Bailey said. (The angle of incidence increases with distance between terminal points.)

NBS tests also indicate that signal intensity varies inversely with the fifth to seventh power of the radio frequency. The fifth power figure is best for radio frequencies of 27 to 49 mc., the seventh power in the range of 49 to 107 mc., Bailey reported.

Experience with the AF's network indicates that a 60-deg. corner-reflector-type antenna provides better performance than the earlier used rhombic type. A new four-array Yagi type also "looks good," Bailey said. The antennas employed are quite large, requiring considerable "real estate," and their siting is quite critical, Bailey noted.

Transistorized Computer

By applying certain exclusive properties of transistors to the design of digital computer circuitry, instead of merely substituting them in conventional vacuum-tube computer circuits, designers can save considerable circuit complexity, numbers of components, and reduce power consumption, Philco's Ralph B. Brown told the IRE. (The paper was co-authored by Philco's Ralph H. Beter and William E. Bradley, with Morris Rubinoff of the University of Pennsylvania.)

▶ **Transac Computer**—Brown described the transistorized arithmetic section of a Philco digital computer called Transac (TRANSistorized Automatic Computer).

The entire arithmetic unit consumes only 5¾ w. at 3 v., and occupies only a 5½-in. cube. It uses no diodes, delay lines, capacitors, or transformers—only 1,242 surface barriers transistors and 322 resistors.

Working with 19 binary digit numbers, the unit can add or subtract in 2.4 microseconds, multiply or divide in 48 microseconds, and shift in 0.4 microsecond.

▶ **Simplified Computer Circuits**—Specific examples of component economy of Philco-developed transistor circuits over comparable tube and tube-diode circuits include:

• **Flip-flop circuit**, employing only four surface barrier transistors and two resistors for operation at 1-2 mc., consumes only 0.018 w. Comparable tube flip-flop (Eccles-Jordan) shown by Brown uses two tubes, two capacitors, four diodes, nine resistors, and consumes 13.4 w. A comparable tube-diode flip-flop circuit employs one tube, one delay line, 19 diodes, one transformer, and consumes 8.25 w., according to Brown.

• **Clocked "or-and-or" pyramid circuit** employs nine transistors and three resistors, consuming only 0.027 w. The comparable vacuum-tube circuit cited by Brown uses nine tubes and 23 resistors, and consumes 23.5 w. The diode-tube version employs one tube, one transformer, 11 resistors, and 25 diodes, consumes 10.4 w.

• **Binary adder circuit** uses 13 transistors and four resistors, consumes 0.36 w. Tube equivalent uses four tubes, one capacitor, 21 resistors, and consumes 21.5 w. Diode-tube version uses two tubes, 26 resistors, 52 diodes, seven delay lines, and consumes 25.5 w., Brown said.

New Techniques

Collins Radio has achieved a 40% reduction in the total number of components employed in its new mobile AN/VRC-24 VHF-UHF transmitter-

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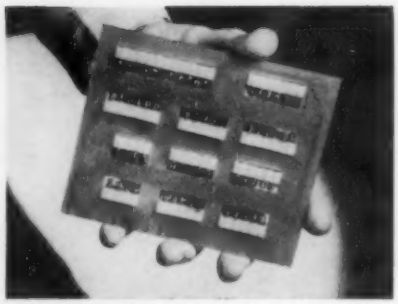

COMPACT MODULE for Transac computer uses transistors and resistors only.

receiver (compared to older airborne 1,800-channel UHF sets now used by USAF and Navy), according to Paul Wulfsberg, by using "novel reflex techniques."

The new VRC-24, developed under Signal Corps sponsorship for ground-to-air liaison use, employs 25 tubes of five different types. This compares with 59 tubes of 21 different types in the ARC-34, Wulfsberg told the IRE convention.

Initial VRC-24 model has conservative service test rating of 2-w. output, compared to ARC-34's 8-w. rating, but a new version of VRC-24 will be rated at 10 w. without an increase in size or weight, he said.

Collins has achieved this significant reduction in tubes and components by designing the VRC-24 so that all tubes and tuned RF circuits are used both in the transmit and receive modes, except for the power amplifier, its plate circuit, and the receiver fixed intermediate amplifier.

▶ **Techniques Widely Applicable**—The techniques employed generally are applicable to any simplex type of multichannel receiver-transmitter operating at or below the same 220-400 mc. frequency range, Wulfsberg said. This includes both the direct-frequency synthesis type circuit employed in the VRC-24, and the indirect type employing crystal-stabilized variable-frequency oscillators.

Reflexing is accomplished with a minimum of radio frequency switching. Injection and intermediate frequency amplifiers are switched by means of dual mixer circuits whose plate voltages are controlled through relays. Interesting byproduct of the reflex design, according to Wulfsberg, is that VRC-24 receiver section can be aligned without the use of an external signal generator.

▶ **Precise Nav-Aid Disclosed**—Jainco, a continuous-wave phase-comparison system, which reportedly is capable of establishing aircraft position to an accuracy of 0.5 ft., was described by Donald H. Jacobs, head of Jacobs Instrument Co., developer of the system. It consists of a master ground station

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plus two slave stations, spaced 10 to 40 mi. apart.

A crystal-controlled oscillator at the master station modulates its carrier with five different frequencies, each 10 times the frequency of the next lower.

Each slave station is equipped to remove the five modulation frequencies from the master station carrier, impose them on new carriers of different frequency, and re-broadcast them.

The result is three different carriers, each modulated by the same basic five frequencies, each transmitted from one of the three ground stations.

▶**Three Airborne Receivers Needed**—In the aircraft, individual receivers are used to demodulate the three carriers, after which filters resolve the modulations into the five individual frequencies.

A phase comparison between f_1 (the lowest frequency) obtained from the master and one slave station gives one hyperbolic coordinate; a similar comparison between the master and the other slave gives a second. These two coordinates establish airplane position.

If f_1 has a wavelength of 360 mi., a phase comparison accurate to 1 deg. resolves airplane position to approximately 1 mi. Phase comparison of f_2 (one-tenth the wavelength of f_1) establishes airplane position to within approximately 0.1 mi., and succeeding phase comparisons of f_3, f_4, and f_5 resolve position down to 0.5 ft., Jacobs said.

Phase comparisons are made automatically and displayed in watt-hour-meter style on a cluster of five small cathode ray tubes. Military security prevented the release of more details, Jacobs said, but he indicated that the carrier frequencies had line-of-sight characteristics.

▶**Hughes Typotron**—By incorporating a storage-tube feature in its Typotron, Hughes is able to eliminate the need for intermediate storage devices required by the Convair Charactron. The HAC tube was described by H. M. Smith, and was displayed in HAC's IRE exhibit.

The Typotron can display any one or combination of 63 different characters on its 5-in. face, holding them indefinitely until erasure is desired. Readout speeds of 25,000 characters per second are possible with the tube, Smith reported.

Like conventional storage tubes, the Typotron employs a storage target upon which the electron beam, shaped to the appropriate character by a small matrix, writes.

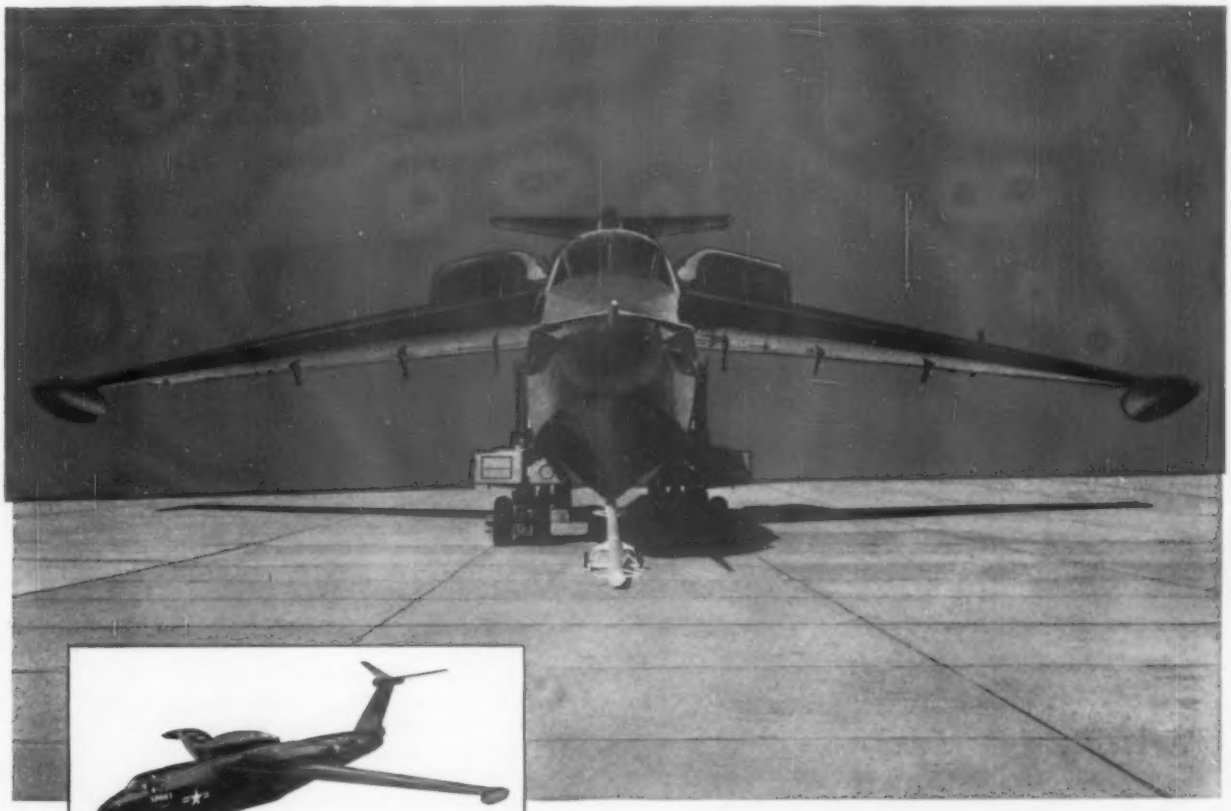
A separate electron flood gun transfers the character from the storage target to the tube's front phosphor face where it is displayed. The displayed characters are $\frac{1}{8}$ in. high.

BARBER COLMAN

Aircraft Controls

selected by Martin for the new Multi-jet XP6M-1 SeaMaster

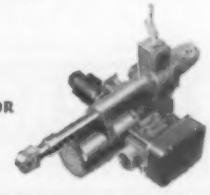
In the "over 600 miles per hour" class and capable of normal cruising at 40,000 feet, the four-jet XP6M-1 SeaMaster heralds a new era for flying boats. Countless advancements calling for many automatic control systems and components are embodied in this new seaplane built for the Navy. For precision operation of several of these systems Barber-Colman controls and components have been chosen. Among them are: stabilizer trim control . . . Hydroflap control . . . auxiliary ventilation control . . . windshield heating control . . . and camera compartment and radome heat control. This utilization of Barber-Colman experienced engineering facilities and products is example again of how this organization teams up with the industry for a constant flow of important new aircraft developments.



TYPICAL BARBER-COLMAN CONTROLS USED ON NEW MARTIN XP6M-1

CONTROL BOX

VALVE



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New Computers Use More Transistors

Completely transitorized digital computors, approximately one-half the size of vacuum tube models and consuming only one-tenth as much power, will be commercially available from International Business Machines Corp. early next year.

The new IBM 608 will use more than 3,000 transitors. Three-dimensional arrays of magnetic cores will be used for internal machine storage and input/-output will be by punch cards. The new machine reportedly will have a computing speed that is 2½ times that of IBM's Type 607 (vacuum tube) calculator. The 608 will be able to multiply two 9-digit numbers in 11 milliseconds, divide in 13 milliseconds. Machine results can be punched out on the cards at the rate of 155/minute, approximately 50% higher than the Type 607.

Other recent computer developments of interest in the aviation field include:

• **Lockheed Aircraft's Georgia Division** recently has put the IBM Type 650 magnetic drum calculator to work at its Marietta facility. Company's Missile Systems Division also is using a Type 650, one of the first models shipped by IBM. Machine will be both for missile system studies and company payrolls.

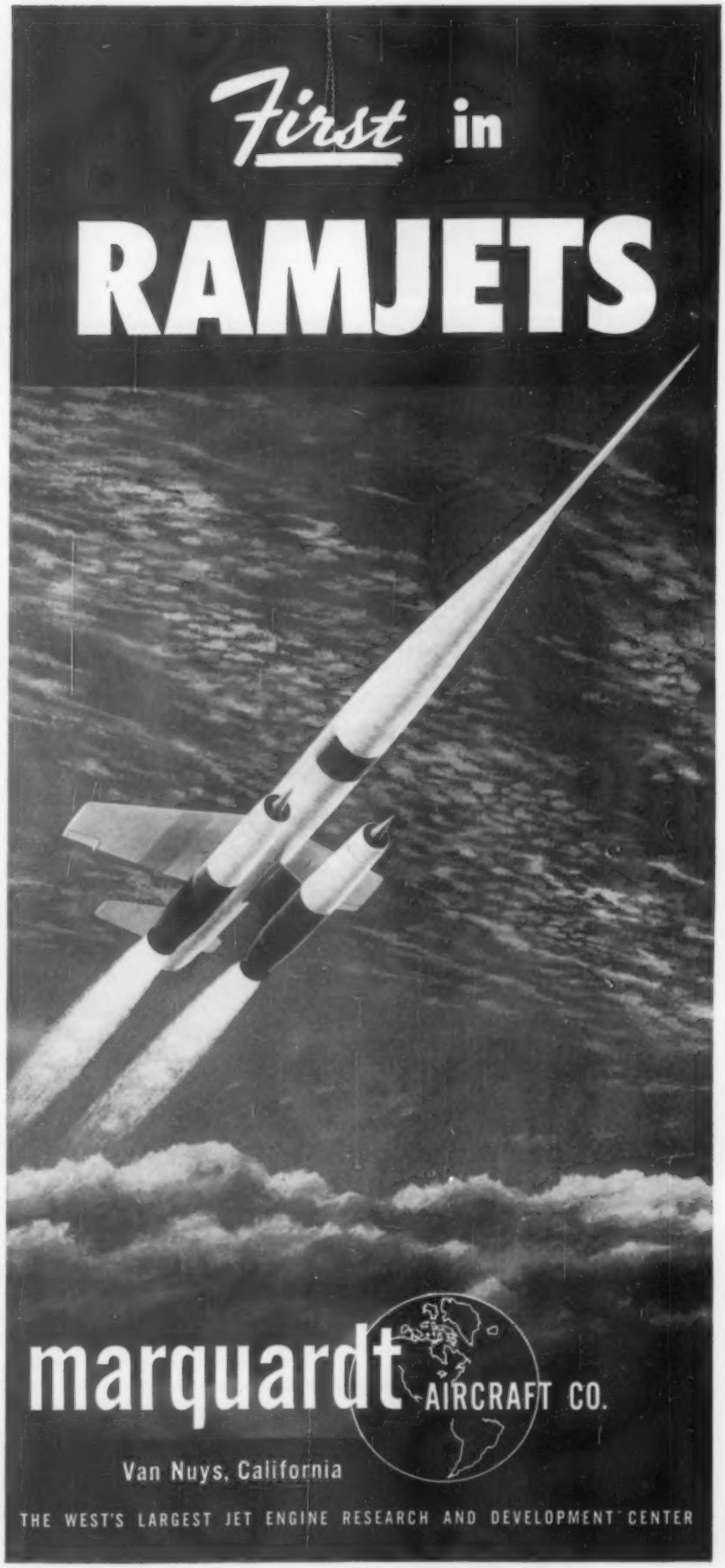
A second IBM 650 is slated to go to Lockheed's missile group in May.

• **White Sands Proving Ground** recently has installed a Remington Rand Univac Scientific computor developed by the firm's Engineering Research Associates Division.

Known as the ERA-1103 when first announced several years ago, the Univac Scientific will be used to speed reduction of missile flight test data, and is expected to handle computations for as many as 10 missile firings a day.

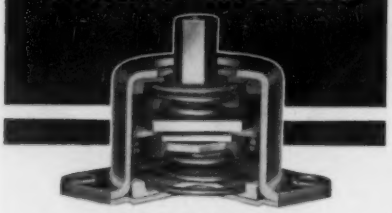
Trial by Cold

This picture was taken at —42F during arctic tests of SPAR radar, low-cost air-transportable GCA, at Ladd AFB, Alaska, by USAF. After the cold-weather tests, the equipment was flown back to Eglin AFB, Fla., where it had previously undergone extensive testing. SPAR is manufactured by Laboratory for Electronics, Inc., Boston.



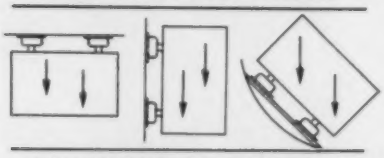
NEW

ALL-ANGL BARRY MOUNT

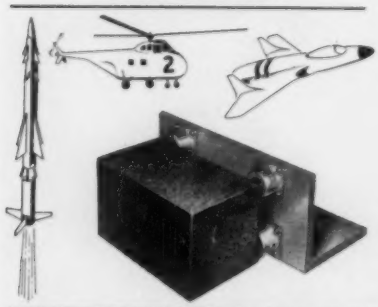


ALL-ANGL BARRY MOUNT
Cup diameter .....1 inch
Maximum load .....3 pounds
Weight .....less than 1 ounce

WORKS AT ANY ANGLE



IN MANEUVERS THROUGH EVERY POSITION



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New Marconi ASR Eliminates 'Clutter'

A new British low-frequency, long-range surveillance radar, whose operation in the 50-cm. region reportedly makes it "virtually unaffected" by precipitation, will be installed soon at London Airport. U. S. long-range ASRs, which operate on 10 cm., are bothered by precipitation unless equipped with circular polarization.

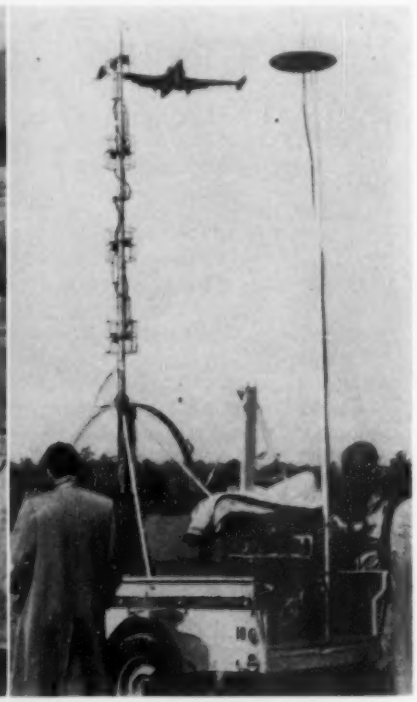
The radar, designed and manufactured by Marconi's Wireless Telegraph Co., Ltd., will serve the Southern Air Traffic Control Center. It is priced at $70,000.

The new S232 set employs crystal control and an extremely efficient MTI (moving target indicator) system to remove unwanted clutter from fixed ground obstacles. This enables set to be used simultaneously for both long-range surveillance (to more than 100 miles) and close-in approach control (down to ¾ miles) when separate Plan Position Indicators are installed, Marconi says. Up to eight PPIs can be used.

▶ **Technical Highlights** — Significant technical characteristics of the new Marconi radar include:

- **Antenna scan:** continuous rotation in either direction at speeds of ½ to 10 rpm., or a reciprocating cycle over an arc of 10 to 60 degrees either side of a preselected bearing, at speeds of 1/17 to 2½ rpm.
- **Peak power:** 50-60 kw.
- **Azimuth beamwidth:** 3½ degrees at half-power points.
- **Vertical coverage:** Approximately 20 degrees.
- **Tilt adjustment:** −1 to +10 degrees.
- **Pulse length:** 2 or 4 microseconds.
- **Pulse repetition rate:** 500 to 800 pps.
- **MTI suppression:** At least 46 db., to maximum radar range.

The new S232 will replace an early developmental model which has been used at London for some time.



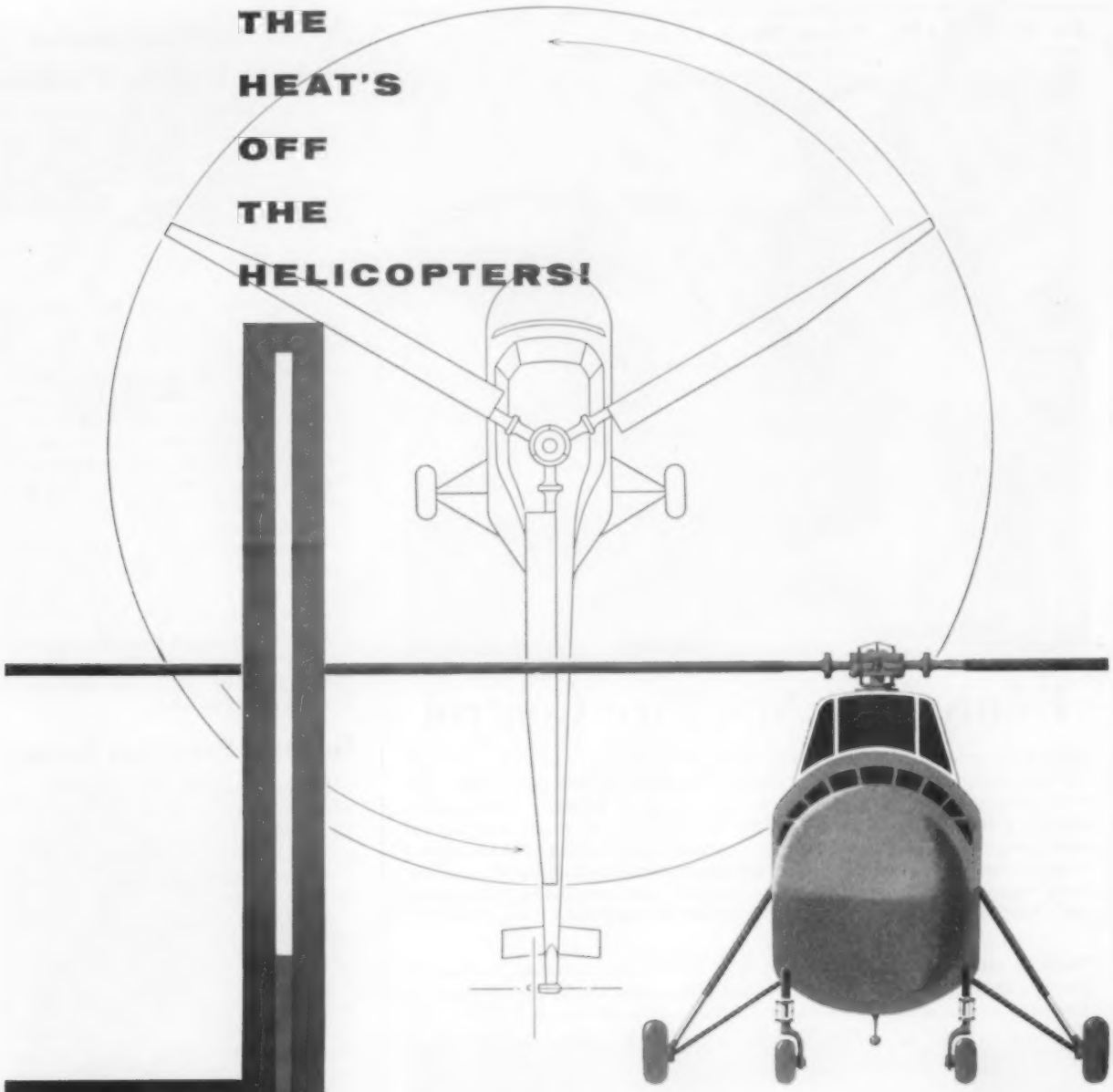
Sperry Tests Robot Intercept System

Remote-control interception of enemy bombers is one possible use for new Sperry system for radio guidance of jet fighters from ground or "mother-ship" beep stations. Another use is for special drone missions, such as nuclear tests.

In new system, drone is not doomed by loss of UHF guidance signals, as in some early remote control systems. A device in the drone automatically takes control when signals are lost for five seconds or more. If plane is below a predetermined altitude, it is put automatically into a full-power climb, dive flaps (if extended) are retracted, and at a pre-selected airspeed, the craft goes into a climbing left turn until it reaches a safe altitude. At this point, altitude control automatically engages, and the plane flies a left-turning orbit until radio guidance is restored.

The new system is a standardized production version of an earlier model developed by Sperry Gyroscope Co., Great Neck, N. Y. Other new features include anti-skid control in the remotely controlled braking system, provision of telemetering information from drone to the ground or mother ship, plus simplified pre-flight maintenance and check-out.

THE HEAT'S OFF THE HELICOPTERS!



A struggling infant a few short years ago—*now the 'copter has won everyone's confidence!* And Harrison oil coolers helped them make the grade—enabled them to fly faster . . . farther . . . with bigger, more profitable payloads. Harrison's unexcelled research facilities deliver the designs that save space and weight. In fact, Harrison is *always* looking for new ways to make aircraft heat exchangers of all kinds lighter, more dependable, more durable than ever! If you have a cooling problem, look to Harrison for the answer!

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORP., LOCKPORT, N. Y.

HARRISON

TEMPERATURES MADE TO ORDER

To Make NATO Sabres More Lethal . . .

F-86Ks Get New Fire Control

NEW MG-4 FIRE CONTROL SYSTEM, developed by North American for its F-86K (20-mm. cannon version of the F-86D being produced for NATO use), enables pilot to fly automatically a lead-pursuit attack course on enemy bombers. System, which employs a Hughes Aircraft radar, provides usual functions of ground mapping and radar navigation in conjunction with ground-based radar beacons. NAA-developed computer and controls, which calculate and display required attack course, maximum firing range and suggested pull-out time to the pilot, were designed by North American's Missile and Control Equipment (MACE) department.

TWELVE MILITARY STUDENTS from three NATO countries—Italy, Norway and France—presently are studying the new MG-4 system, after which they will return to Europe to serve as interpreter-instructors. System is in production at NAA-Downey.

Avionics Companies Report Higher Profits

Annual reports recently issued by several major avionics firms show that profits before and after taxes are up, compared with 1953, despite lower sales in some instances. Highlights of the yearend report follow:

Sperry

Sperry's net income after taxes in 1954 totaled $28,454,002, up 80% over the 1953 figure despite a 5% drop in shipments, which ran $440,906,187 for the year. Although lower taxes played a major role in the 80% increase, profit before taxes was up approximately 10% over last year. Sperry's net earnings per share were $6.55, up 73% over last year, while dividends were $1.75 a share, an increase of 17%.

Yearend backlog was $446,559,000, approximately 17% under last year's figure. Sperry's report notes that the company participated in 10 guided missile projects, ranging from its own small air-to-air missiles. (Sparrow 1), now in production, to large intercontinental bombardment missiles.

General Precision Equipt.

General Precision Equipment Corp., which last year added Link Aviation to its stable of electronics and avionic companies, boosted its net sales to $123,332,634 last year, an increase of 40% over the previous year.

Profit before taxes was $12,019,467, up 48% over the previous year, while profit after taxes was $5,488,090, an increase of 60% over 1953. GPE's net profit after taxes was $5,488,090, a 28% increase over 1953, while dividends per share were $1.90, a 90% increase.

Major GPE divisions active in the avionics field, in addition to Link, include Librascope, Inc., General Precision Laboratory, Inc., and the Kearfott Co.

GPE's yearend backlog for the armed services was $94,036,000, down approximately 3% from the previous year.

GPE's anual report states that quantity production has begun on "the most advanced system of automatic airborne navigation known to exist . . . (culminating) eight years of . . . research, development and design activity which has been centered primarily in one of the GPE companies and supported by the facilities and personnel of other GPE companies."

Hoffman Electronics

Hoffman, which has substituted "Electronics" for "Radio" in its corpo-

who co-pilots the F-100?

that's a good question—

Particularly considering the fact that the F-100 is a single-seat fighter!

The extreme high speed of the F-100 makes things happen pretty fast for the pilot, so a "built-in" co-pilot is used. In this instance, a vital part of the co-pilot consists of a damping system that immediately and automatically senses and corrects the slightest variation in the smooth flight path as controlled by the pilot.

Important components of this "flight team" are MINIATURE RATE GYROS produced by American Gyro.

STANDARD MINIATURE RATE GYROS

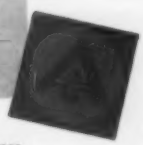
- **Damping ratio — as required (tolerance 0.2 critical over the AN temperature range — no heater)**
- **Motor excitation—26 or 115 volts AC, 400 cycles or 26 volts DC**
- **Vibration — operational through 10 G's from 10 cps to 2000 cps**
- **Acceleration—100 G's along any axis**

Openings Are Available For Highly Qualified Engineers

STANDARD MINIATURE RATE GYROS ARE IMMEDIATELY AVAILABLE IN PRODUCTION QUANTITIES

AMERICAN GYRO

DIVISION OF DAYSTROM PACIFIC CORP.



CONTROL SYSTEMS, STABLE PLATFORMS, MINIATURE AND SUB-MINIATURE RATE GYROS, VERTICAL GYROS, FREE AND DIRECTIONAL GYROS, ACCELEROMETERS, INTEGRATION, INTERVALOMETERS, POTENTIOMETERS, SYNCHROS, RESOLVERS, SENSING AND ACTUATING COMPONENTS.

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minute men

WHEN SECONDS MEAN SURVIVAL, ground support equipment of unquestionable reliability is the indispensable factor. As a pioneer in all phases of ground support, CONSOLIDATED has developed units of broad application for maintaining missiles or piloted aircraft at a constant ready. Through design, development and manufacture, we have solved the most complex problems of providing self-propelled, multi-purpose units . . for towing, testing, servicing and starting guided missiles and jet aircraft . . . . . quickly, surely and under the most difficult operational conditions. Several of CONSOLIDATED's models are now being used extensively by the U. S. Air Force, Navy and Marines.

MODEL 2100 INCORPORATES HYDRAULIC, A. C., D. C. ELECTRIC, AND TOWING.

IN THE EXACTING FIELD OF GROUND SUPPORT, CONSOLIDATED HAS DEMONSTRATED ITS ABILITY TO MEET THE MOST COMPLEX DEMANDS

CONSOLIDATED
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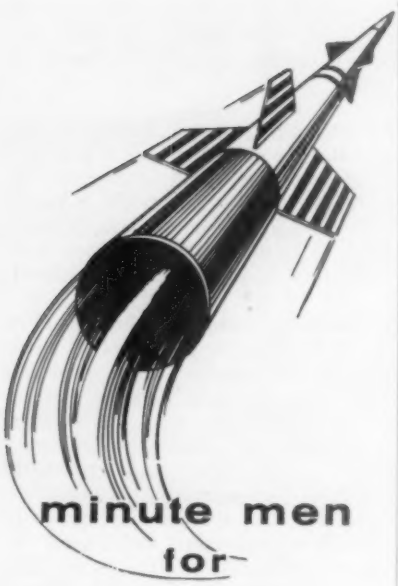
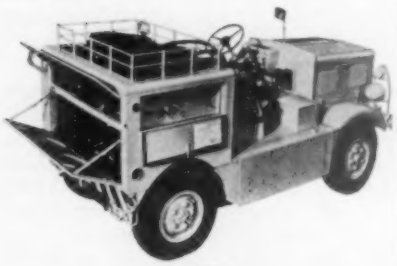
STAMFORD, CONN. BRANCHES · DALLAS, TEX. · DAYTON, OHIO · SANTA ANA, CAL. · WASHINGTON, D. C.





Model 2100,

GROUND SUPPORT

This compact self-propelled multi-purpose unit, Model 2100, performs all requirements of electrical, hydraulic, and pneumatic testing and servicing of guided missiles . . . and can be used for heavy duty towing. It provides:

- HYDRAULICS . . . 10 gpn, 3000 psi variable volume, pressure compensating.
- A.C. POWER . . . . 30 KVA, 400 cycles, 3 phase and 10 KVA single phase, close regulated.
- D.C. POWER . . . 28.5 volts, 500 amp continuous.
- TOWING . . . All wheel drive, over 5000 lb. drawbar pull.

Other models of single and multi-purpose Ground Support equipment are available with hydraulic systems . . . any combination of A.C. and D.C. power . . . high and low pressure pneumatic systems . . . refrigeration and heating.

CONSOLIDATED
DIESEL ELECTRIC CORP.
STAMFORD, CONN
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rate name to reflect better its diversified activities, particularly in the avionics field, racked up $42,647,008 in sales last year, approximately 15% under the previous year.

Despite this, profit before taxes reached $3,202,513, up 5% over 1953, while profit after taxes totaled $1,485,513, an increase of 24%. Net profit per share was $2.08, a 24% increase over 1953. The $1 dividend was the same as in the previous year.

Hoffman's stock was listed for the first time on the New York Stock Exchange beginning Jan. 10, 1955. Company capital was increased last year by approximately $4.25 million as the result of a 15-year loan from the Metropolitan Life Insurance Co.

Airborne Tacan receivers and Navy shipboard radio transmitters, two of Hoffman Laboratories' biggest military production contracts, are expected to be in full-scale production by mid-year, the report states.

Company says it has achieved "an outstanding reputation in noise reduction techniques" and that its patented Hoffman Incremental Suppressor, "most advanced unit yet developed in the field of noise reduction," has been licensed to several other firms for manufacture and sale.

FILTER CENTER

▶ **Tinkertoy Plant up for Sale**—Original Project Tinkertoy pilot plant in Alexandria, Va., which has been operated for Navy by Willys Motors' electronics division, soon will be put up for sale or lease to a firm in the electronics industry, it is reported.

▶ **Bell Pushes Inertial Navigation**—Bell Aircraft Co. is advertising widely for experienced engineers for inertial navigation system work, an indication of growing activity and progress in this field.

▶ **Automation Symposium Scheduled**—Stanford Research Institute and USAF jointly will sponsor the second of their annual symposiums on automatic production of electronic equipment, Aug. 22-23 in San Francisco. The SRI-USAF symposium will dovetail with Wescon, which will be held Aug. 24-26 in the same city.

▶ **New Decca Chain**—The Swedish government will install a new Decca navigator chain of ground stations, centered at Stockholm.

▶ **Bright Idea Needed**—One military need currently crying for solution is a moving target indicator (MTI) for use in flying picket ships which will be

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"Pioneers in Pneumatic Systems for Aircraft"
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High and Low Pressure Regulators
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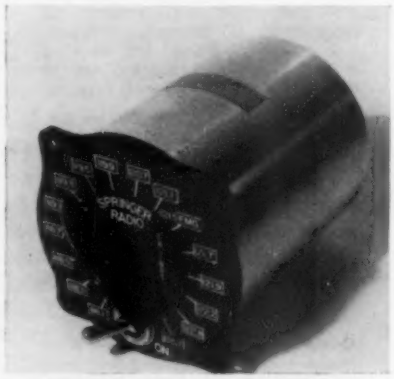
"sensitive" to movement of target aircraft, but "insensitive" to movements of the airborne radar itself, aboard the picket.

▶**NEC Proceedings Available**—"Proceedings of the National Electronics Conference" of 1954, containing 86 technical papers totaling 872 pages, is now available in bound form. Price is $5.00. Copies may be obtained from NEC at 84 E. Randolph St., Chicago 1.

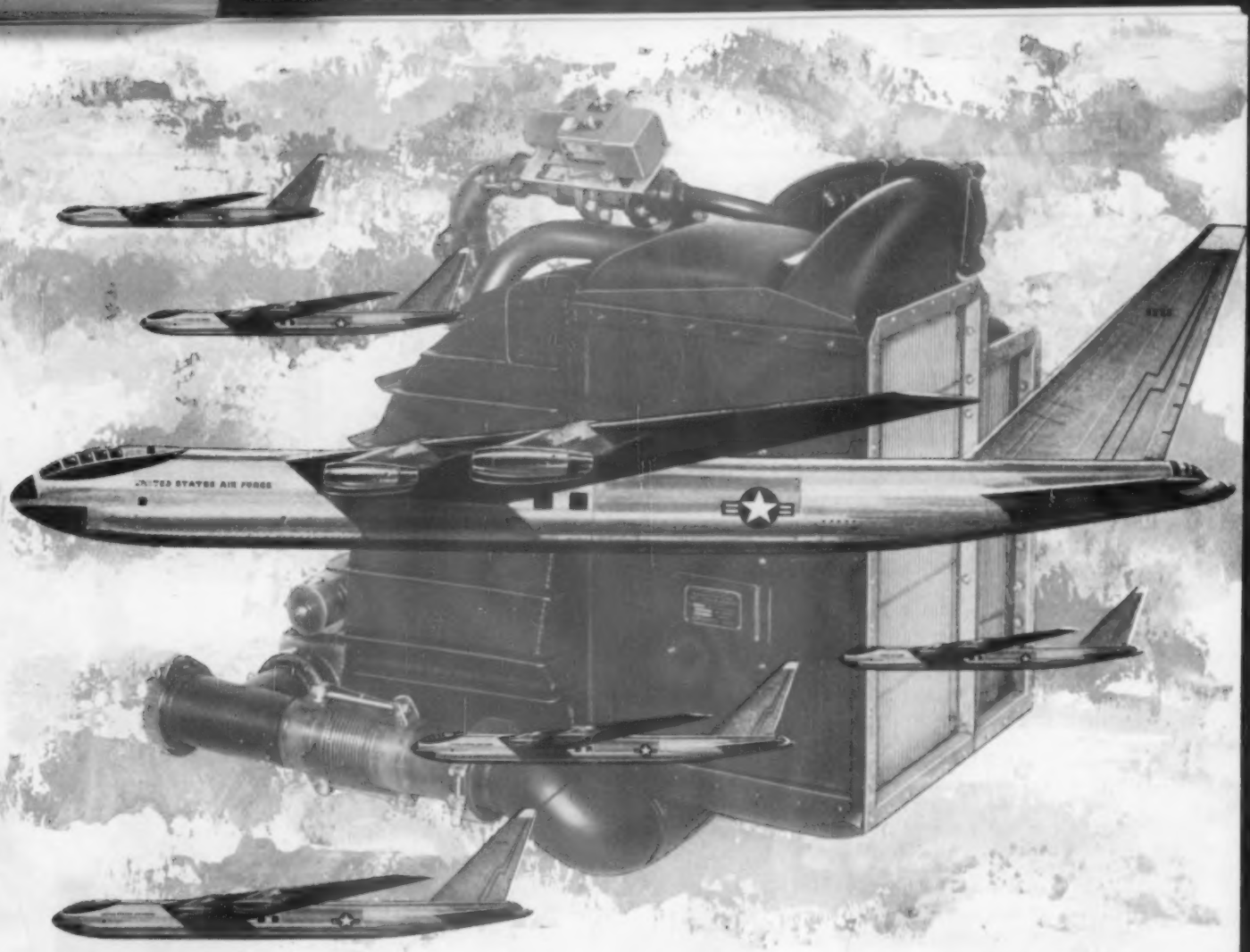
▶**Computer Summer School**—University of Michigan will conduct an intensive summer session course in digital computers and data processers for engineers, mathematicians, and management scientists. University will offer both general background courses in computers, programming, and application, as well as specialized programs in computer engineering and logical design. Further information is available from Dr. John W. Carr III, Digital Computation Dept., Willow Run Research Center, University of Michigan, Ypsilanti, Mich.

▶**Relay Conference Report**—A 70-page brochure, containing 23 technical papers presented at the Third National Conference on Electromagnetic Relays (held Mar. 9-11 at Oklahoma A&M College), is now available from Potter & Brumfield Manufacturing Co., Princeton, Ind., a subsidiary of American Machine & Foundry Co. Requests for copy should be made on company letterhead.



Simplifies Tuning

A lightplane pilot can tune in control tower frequency more easily if his continuously tunable receiver is equipped with a new VHF calibrator. When pilot selects desired frequency, calibrator emits low-power modulated signal to which receiver can be tuned by ear. Calibrator shown above, made by Earl W. Springer Aircraft Radio Co., Box 330, Indianapolis, Ind., is priced at $68.75 with three crystals, $172.75 with 16 crystals. Functionally similar unit, called Selecto-Tuner, is made by Max-Sig Communications, P. O. Box 522, Medford, Ore.



STRATOS

AIR-CONDITIONS THE NEWEST USAF BOMBER

THE EIGHT-JET BOEING B-52

The Boeing B-52 jet bomber entering operational service with the Strategic Air Command this spring becomes the world's first heavy jet bomber to go into service.

Joining its medium jet bomber teammate in SAC—the Boeing B-47—the B-52 "Stratofortress" greatly strengthens America's Air Arm. A high flying, high speed heavyweight with a range longer than that of any other operational jet aircraft, it is destined to be the backbone of SAC's striking force for some time to come.

To cool the crew and the tons of intricate equipment aboard the B-52, Boeing picked a highly efficient cooling system designed and produced by Stratos.

Builders of precision equipment for aircraft systems

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Ejection Seat Design: Two Approaches

By George L. Christian

Two new ejection seats developed for highspeed military aircraft show two different approaches to seat design.

• **Republic Aviation Corp.** seat for the F-84F and RF-84F was built with emphasis on standardization and adaptability to many aircraft.

• **Chance Vought Aircraft** unit for the F7U-3 emphasizes weight reduction without compromising pilot safety. It is based on concepts developed by Douglas Aircraft Co. for the A4D Skyhawk (AW Jan. 24, p. 30).

The Republic-Air Force seat incorporates protective leg braces, the Chance Vought-Navy seat does not. CVA says survey figures show that 25% of pilots using ejection seats in over 500 bail-outs since World War II forgot or failed to use the stirrups.

Another dissimilarity is in ejection procedure. The Republic seat requires the pilot to raise leg braces and squeeze a trigger, which can be done in rapid succession or with a delay between motions and with either hand. The Chance Vought seat uses the face-curtain type of firing motion.

Design of the 60-lb. Republic unit was based on "an analysis of latest and anticipated escape system requirements as established by the Special Projects Branch of USAF's Aircraft Laboratory at Wright Air Development Center."

The CVA seat weighs 30 lb., compared to 130 lb. of previous seats installed in the company's F7U-3s. Another company working now on ejection seat projects is the Stanley Aviation Corp.

▶ **Republic Seat**—Here are some refinements in the Republic seat:

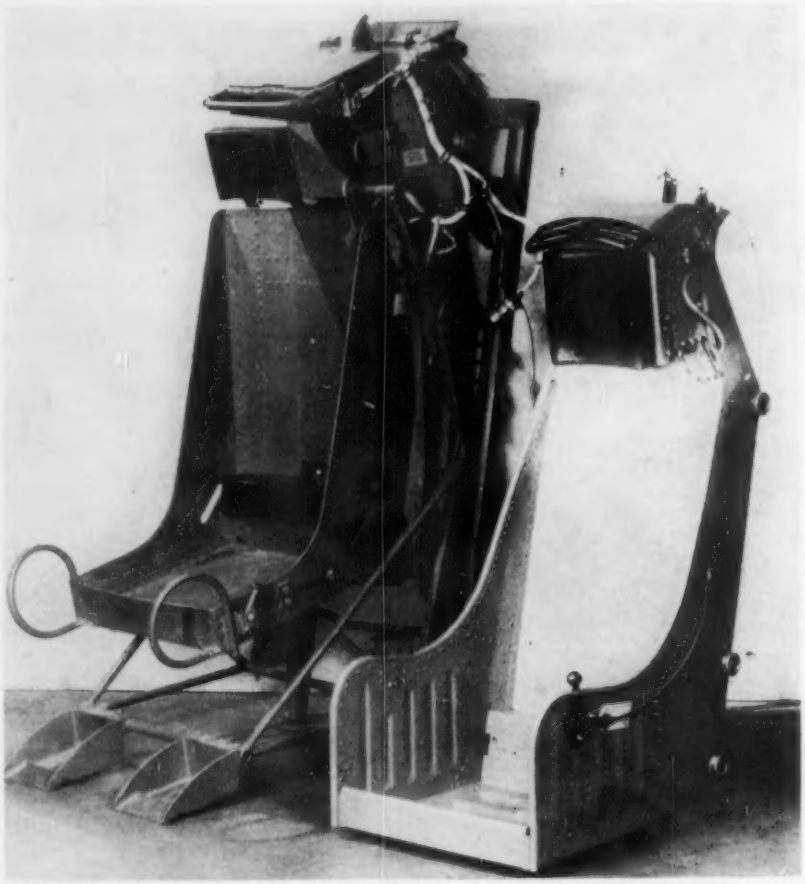
• **Seat back beam** is a separate subassembly, making it easy to adapt the basic seat to various aircraft having compatible cockpit layouts.

• **Structural rigidity** allows the seat to be ejected at maximum speeds of the fastest aircraft, ranging into the supersonic. This feature also reduces the danger of the seat "jumping the tracks" during high deceleration landing accidents.

• **Use of multi-purpose components,** straightforward design, and simplified construction minimizes possibility of incorrect installation. Because it is adaptable to many aircraft, mass production of the seat may be possible, along with simplified inventory and logistics problems.

▶ **Ejection Procedure**—Pre-ejection procedure requires pilot to raise protective leg braces; this lifts the arm rests, locks the shoulder harness, jettisons the canopy, arms the catapult trigger, decompresses the cabin and moves gunsight and the control column out of the way.

Ejection is accomplished by squeez-



NEW EJECTION SEAT (right) for Cutlass is 100 lb. lighter than old (left).

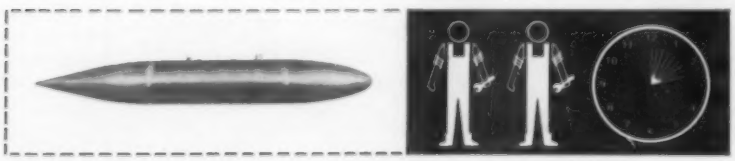
REPUBLIC SEAT can fit various aircraft. Normal position (l.), ejection (r.).

THE INDELIBLE IMPRINT OF SKILLED HANDS

NEW ROYAL JET WING TANK DESIGN
CUTS ASSEMBLY TIME TO 13 MAN MINUTES

The moment man became airborne the race began to advance the science of flight. The skilled hands and productive minds of an imaginative industry have kept America in the lead. The skilled hands of Royal Jet specialized production engineers help to maintain the pace with new production techniques.

EXAMPLE: Royal Jet, the first, and today only producer of hi-nesting fuel tanks has perfected a new joint design to speed assembly. 2 men can now completely assemble a 450 gallon, hi-findness ratio tank in 13 man minutes. Formerly, assembly required a full 1½ man hours.



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If you are an aeronautical engineer searching for a future, write Royal Jet stating your qualifications.

Ask the pilots with the most experience . . .

Joan Tesch and Albert Swartz, co-owners of the Sky-Way Crop Dusting Co., stand with one of their crop-dusting fleet.

ask Albert Swartz . . .
ask Joan V. Tesch . . .

CO-OWNERS AND PILOTS FOR SKY-WAY CROP DUSTING COMPANY, MARSHALL, MICHIGAN

Joan V. Tesch, possibly the only lady "crop duster," says: "I've flown the last 8 years with Gulf products. There aren't any aviation products better for our specialized type of flying."

Albert Swartz says: "I've been an exclusive user of Gulf Aviation Products for the last 4 years. I consider Gulf Aviation Gasoline and Gulf Oils as real insurance against engine trouble."

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Gulfpride Aviation Oil, Series-D

For horizontally opposed and Ranger in-line engines. Minimizes ring and valve sticking, oil consumption, oil-screen clogging and plug fouling. Users of this great detergent oil have increased periods between engine overhauls by as much as 100%.

Gulf Aviation Gasoline

It's "refinery-clean" for your safety because Gulf Aviation Gasoline dispensing units are equipped with advanced Micronic Filters.

GULF OIL CORPORATION · GULF REFINING COMPANY

ing a trigger. This blows out seat and occupant, disconnects oxygen and electrical connections and engages a time-delay device to release the seat in two seconds—when the pilot is at the height of his arc, away from the aircraft.

Safety devices prevent inadvertent operation of pre-ejection and ejection mechanisms.

Maximum possible guided stroke for satisfactory ejection trajectories has been assured by use of efficiently installed slide blocks, Republic says. In the F-84F and RF-84F, there is 25% increase of minimum guided stroke without structural changes in fuselage or cockpit, according to the manufacturer.

Republic has a patent pending and has licensed Aircraft Mechanics, Inc., Colorado Springs, Colo., to manufacture and sell the seat. It also will be offered to NATO air forces through Republic Aviation International S.A., Lugano, Switzerland.

▶ **Chance Vought Seat**—Weight saving of the CVA seat was achieved by eliminating such items as the stabilizing drogue parachute, seat adjustments for tilting and forward-backward movements, pre-ejection controls, and the leg braces and foot stirrups, as in the Douglas A4D seat.

The pilot still can adjust the seat for height along the seat's tilted axis.

▶ **Procedure**—Since there is no pre-ejection handle the pilot merely pulls the face curtain down to eject himself.

During the first part of the seat's travel it locks the pilot's shoulder and lap harnesses automatically, jettisons the canopy and ejects seat and pilot using the Navy 20G cannon as power source. If the automatic harness disengagement mechanism fails the pilot can free himself from the seat by using a handle on its side.

The Chance Vought seat, like the Douglas A4D unit, follows much of the simplicity found in German jet and rocket plane ejection seats used in the final phases of World War II.

377 Vs. 707

Simplicity of a jet transport's cockpit is underlined by these Boeing figures, comparing the company's piston-engine Model 377 Stratocruiser and its jet Model 707 Stratoliner.

Number of display items (warning lights, instruments, gages, etc.) have been sliced 49%, from 195 to 100, while number of controls have been cut 44%, from 370 to 205.

As Boeing puts it: "Cockpit complexity of the four-jet, 550 mph. 707 is directly comparable to the twin-engine, 175-mph. DC-3."

MEMO FROM KAWNEER

SUBJECT: How cockpit enclosure contracts with Kawneer pay off in QUALITY, ECONOMY, DELIVERY.

Gentlemen:

When you negotiate contracts for cockpit enclosures, please consider a COCKPIT ENCLOSURE SPECIALIST such as Kawneer, who can offer a "cockpit package." This package includes engineering, design, tooling, and production which are important advantages available to you by using integrated Kawneer facilities:

1. Your engineers and designers are free to carry on other work. The burden is in the hands of Kawneer engineers.
2. You are released from the responsibility of tool design and tooling, leaving more time for the production of the basic product.
3. You receive the economical advantages of having both the transparent plastic, glass, and metal work handled by one supplier.
4. You are relieved from the responsibility of coordinating a number of vendors making sub-assemblies for major assembly.
5. Your changes and improvements can be handled in the most economical manner because all facilities are under one roof.
6. You receive, because of all these integrated facilities, a complete unit which only needs attaching to the fuselage.

As specialists, Kawneer continues to work on the over-all improvement of the product by injecting new engineering ideas and materials into the operation.

Yours truly,

Aircraft Products Division

SINCE 1907 FABRICATORS OF METAL AIRCRAFT ASSEMBLIES AND ARCHITECTURAL PRODUCTS

Write for the new 24-page book for complete facility details.

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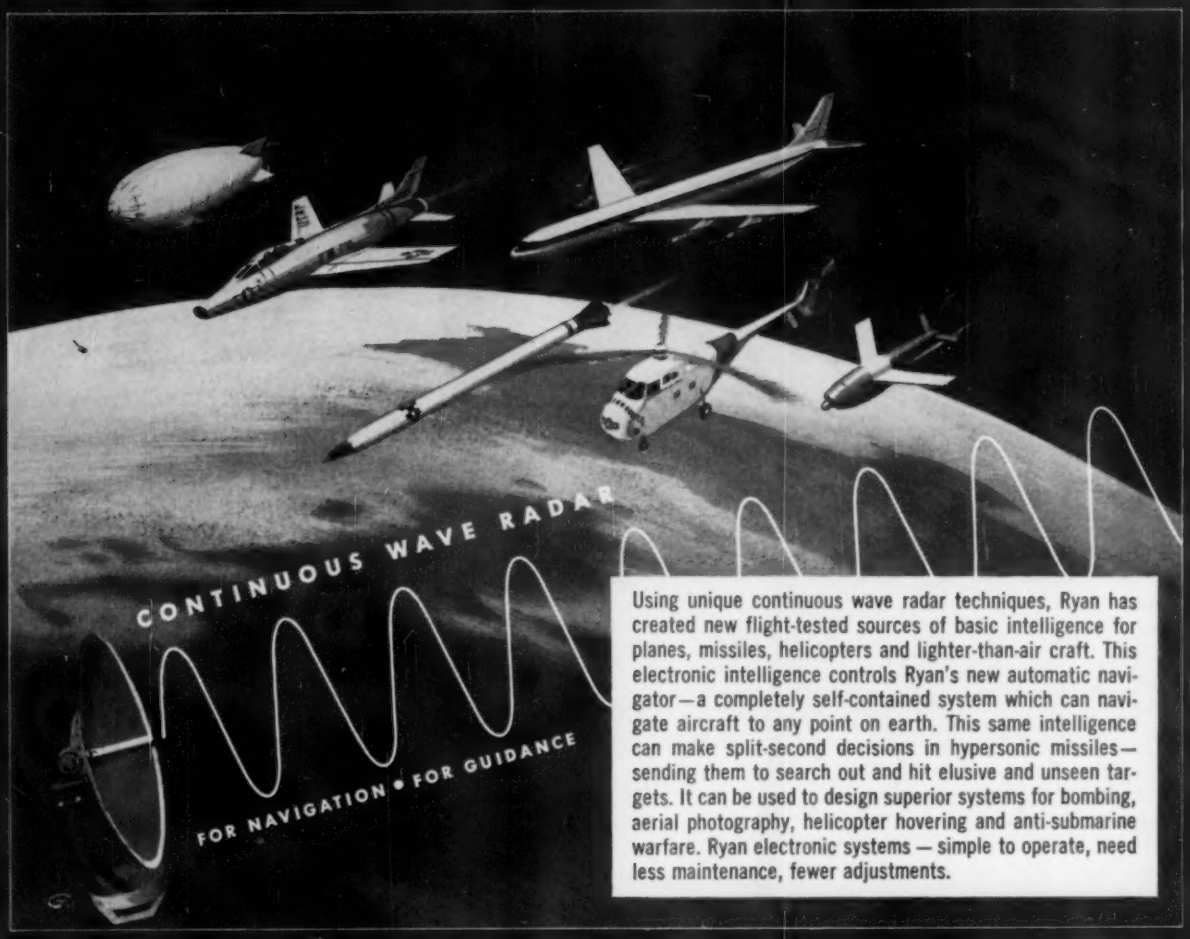
AIRCRAFT PRODUCTS DIVISION

Ryan Electronics "Guides" U.S. Airpower



Using unique continuous wave radar techniques, Ryan has created new flight-tested sources of basic intelligence for planes, missiles, helicopters and lighter-than-air craft. This electronic intelligence controls Ryan's new automatic navigator—a completely self-contained system which can navigate aircraft to any point on earth. This same intelligence can make split-second decisions in hypersonic missiles—sending them to search out and hit elusive and unseen targets. It can be used to design superior systems for bombing, aerial photography, helicopter hovering and anti-submarine warfare. Ryan electronic systems — simple to operate, need less maintenance, fewer adjustments.

Another Example of How

RYAN BUILDS BETTER

Recognized as a leader in electronics, Ryan has the skilled personnel and experience to meet the most complex navigation and guidance requirements. Beginning with the miniaturized radar equipment for the first air-to-air missile —the Ryan Firebird of 1946—Ryan has consistently solved the "can't be done" problems.

Ryan is also pioneering in the development and manufacture of power plant equipment and airframes, including afterburners and other components for jet engines, complete rocket motors for missiles, and vehicles of advanced aerodynamic design. Among the achievements resulting from this engineering effort are Ryan's new jet-powered VTO aircraft, now building, and the Firebee drone missile. Because Ryan blankets all three elements of flight research and development—power plants, aircraft and electronics—it is uniquely equipped to solve the toughest problems of modern flight.

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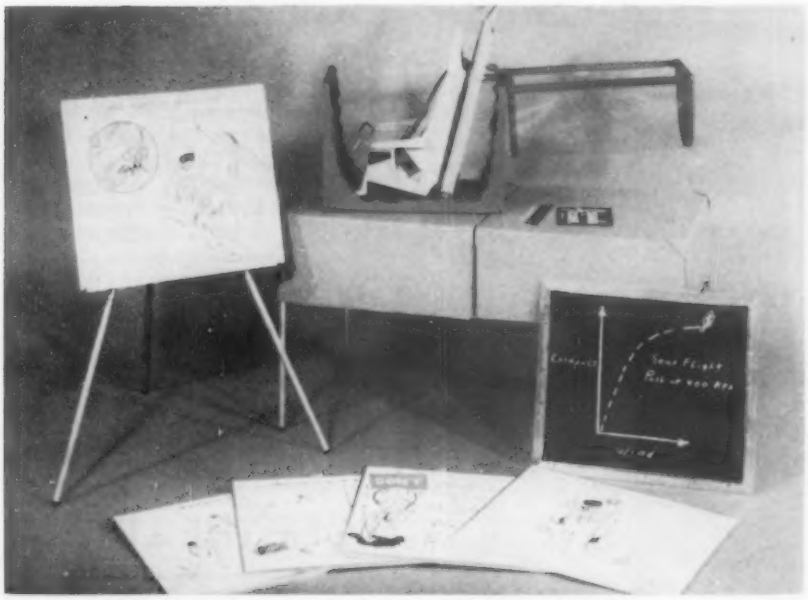


PORTABLE 'TRAINER' comes in suitcase, is easily set up in a few minutes.

'Capsule' to Teach How to Eject

Buffalo—An ejection seat "capsule trainer" that can be carried by two men and contains everything needed for ejection instruction is being built by Carmody Corp. USAF has ordered 41, at a price of $680 each.

The trainer measures 30x30x20 in. and weighs 125 lb. The capsule contains all the information charts, "do's" and "don'ts," working models of seat and associated mechanism, and other components in an easily transportable package that can be set up quickly for pilot instruction.

Being inexpensive, large numbers of capsule-type trainers can be provided, Carmody says, not only at training headquarters, but at operating bases where they can serve as refresher training devices.

Being self-contained and not requiring any power supply, the trainers can be set up anywhere—on the ramp, in a ready room or class room. The trainer can be opened and readied for business by one man in minutes. Trainer case serves as a table on which the instructor places the device's instructional aids.

Oversize, three-dimensional, two-scale panels demonstrate to students the actual operation of all working gear associated with the ejection mechanism. Among them is a panel which shows how the seat is automatically released from the pilot two seconds after ejection (when he is at the peak of his ejection trajectory). Also included is a panel demonstrating the automatic parachute opening device.

A half-scale working model of an ejection seat, complete with canopy, is used by the instructor to identify and explain the function of all ejection seat components. He also uses it to explain the reasons for going through the prescribed ejection procedure, to show how to assume correct body position prior to ejection, and the movements to make for correct ejection.

Carmody is also working on capsule trainers for other flight crew procedures.

Fluoridated Oil Shows Jet Promise

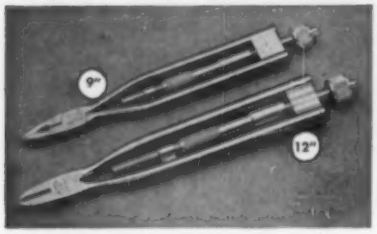
New fluorine-containing synthetic lubricating oils, which are not decomposed by temperatures as high as 500F, should find applications in aircraft gas turbines and new high-temperature electric motors and generators, a Navy chemist reports.

The synthetic fluids are said to equal petroleum oils in lubricating quality and are less susceptible to fire and explosion hazards, but their greater weight may be a drawback. Known as diesters of fluoroalcohols, they withstand high temperatures because of the fluorine atoms attached to the ends of the molecular chains.

Details of tests made by the Surface Chemistry Branch, Naval Research Laboratory, Washington, D. C., were recently given by Harold Ravner, a physical chemist at the laboratory, to the American Chemical Society in Cincinnati.

Ravner said that greases based on the fluorine-containing esters also have been prepared, and experience shows they may be useful in anti-friction bearings operating at elevated temperatures.

ROBINSON WIRE TWISTER
now in 2 sizes!



New 9" Slendernose for bench work on magnetos, carburetors, instruments and sub-assemblies. 12 oz. weight.

12" Standard for assembly line safety wiring. 15 ounce.

Split second whirling action safety wires 3 engines in time formerly required for one. Saves as much as $140 per engine assembled.

3-tools-in-1 — Pliers . . . cutters . . . twisters.

Side cutting, oil tempered heads.

Permanent bronze bearing, no adjustments.

Jaws lock on wire, can't slip off.

Unconditional money back guarantee.

Write for details including prices, testimonials and list of users. **RALPH C. ROBINSON CO., Box 494-521, North Sacramento 15, Calif.**

STRESS AND STRUCTURES ENGINEERS

Many challenging new stress and structures assignments in jet aircraft, guided missiles, and thermo-elasticity are available at Northrop Aircraft, Inc. Engineers qualified will be offered unequaled scope and job diversification and too, will be supported by Northrop's world-famed computing facilities. Thus, each individual will be afforded opportunities to develop to the utmost within his elected field.

Contact:
Engineering Personnel Manager

NORTHROP
Aircraft Inc.,
HAWTHORNE, CALIFORNIA
Phone: Oregon 8-9111 Ext. 1893

Edgewater

rolled steel

rings

for

jet engine

parts

• save machining time

• save costly material

Edgewater weldless rings, rolled from solid steel blocks, are made in diameters from 5 inches to 180 inches, and weights up to 14,000 pounds. The cross-section drawings above show some of the shapes produced by the Edgewater rolling process. Simple or complex sections are accurately formed, minimizing machining operations, and reducing material costs.

Among the applications for which Edgewater Rolled Steel Rings are recommended are: turret gears, shroud rings, compressor rings, spacer rings, parts for reciprocating engines.

WRITE for free booklet describing how Edgewater Rolled Steel Rings are made and showing some of the rolled-sections produced by this process.

EDGEWATER STEEL COMPANY

PITTSBURGH 30, PA.

AF Manual Outlines Equipment Design

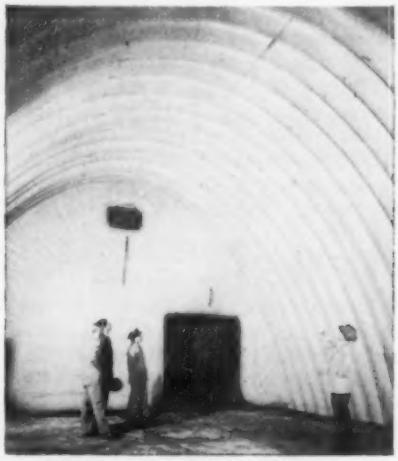
Handbook of Instructions for USAF Ground Equipment Designers presents basic requirements for armament, communication, navigation, photographic and recording, aircraft support, training, rescue, aerial delivery, general base installations, meteorological, administrative, supply, transportation and personal equipment.

Instruction manual was prepared for Air Research & Development Command by Becker & Becker, New York. Write: Commander, Wright Air Development Center, Wright Patterson AFB, Ohio, attention: WCXH.

OFF THE LINE

Charles Butler Associates is new name of the industrial design organization formerly known as Butler-Zimmermann, Inc. BZ handled interior design for TCA's and Capital Airlines' Vickers Viscounts. Charles Butler heads the new firm. Address: 19 E. 53rd St., New York, N. Y.

Aeroquip Corp., aircraft hose manufacturer, has acquired Marman Products, Inc., maker of clamps, flex joints and valves, as a step in Aeroquip's program of expansion and diversification.



Arctic Rubber House

Air contained in 24 arched rubber tubes provides sufficient structural strength so that this rubber shelter can withstand 80-mph. winds and take snow loads of 24 tons. For U. S. Air Force use in the Arctic to house 30 men and radar plotting and tracking gear, the rubber shelter weighs 7,500 lb. It was developed by B. F. Goodrich Co.'s Industrial Products Division, Akron, Ohio in cooperation with Bendix Radio Division, Baltimore, Md., and Rome Air Development Center, N. Y.

A MESSAGE TO ENGINEERS
WHO SEEK NEW SCOPE FOR THEIR ABILITY

"FAIL-SAFE" STRUCTURES DESIGN

The "fail-safe" approach has been applied to various fields of engineering.

However, because of technical difficulties it has been used only to a limited degree in aeronautical structural engineering.

In fact, it stands today as a new concept in aircraft structures, although a number of "fail-safe" principles are found in current Lockheed production aircraft.

Now, Lockheed's Structures Division is initiating an extensive series of studies on the application of "fail-safe" structures design to virtually all types of aircraft.

It is a major effort.

J. F. McBrearty, Chief Structures Engineer, and E. H. Spaulding, Structures Division head, are directing the studies.

It is Lockheed's belief that engineers associated with this program will participate in some of the most significant advances yet achieved in aeronautical structural engineering.

The program's broad scope has created a number of new positions on all levels for engineers with structures training.

Engineers who wish to participate in research and development work on "fail-safe" structures are invited to write E. W. Des Lauriers, Dept. S-3-4.

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We believe we can offer you an opportunity to improve your position in the business world – and improve your way of life here at Rohr Aircraft Corporation in beautiful, temperate, exciting Southern California. To strengthen our personnel in various departments, Rohr has a real opportunity for you if you are skilled as an –

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Please write giving complete details and we will answer immediately.

Mr. Ned DeWitt, Personnel Department 14
Rohr Aircraft Corporation
Chula Vista, California

9 miles south of San Diego on sunny San Diego Bay.

Laminated Plastics Resist Moisture

Resistance to moisture, particularly in humid climates, is claimed feature of three new thermosetting laminated plastics available in sheet, tube or special forms and applicable to electronic and precision devices.

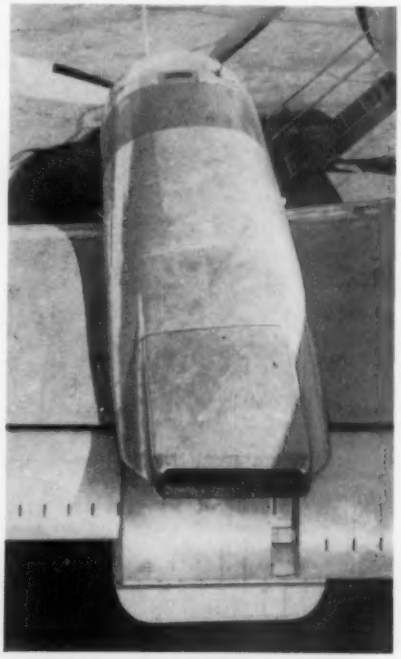
- **DAP-impregnated canvas C-104** is economical, easily machined.
- **Orlon 0-104** shows little change in power factor and dielectric constant after water immersion tests.
- **Woven glass-cloth G-104** possesses the best electrical properties in the dry condition, but shows a higher rate of change when subjected to moisture.

Orlon 0-104 will take continuous temperature of 225F; canvas, 275F and G-104, 350F.

Herbert Widdop, Synthane Corp., Oaks, Pa.

New Survival Outlet

Air-Sea Rescue and Survival Division established by Best Aircraft Corp. Division will supply life vests, rafts, exposure suits, first-aid kits, flares and related products. Nicholas V. Wetzel will head up the new division at 210 W. Bigelow St., Newark, N. J.



Convair Quiets 340

Silencer for the Convair 340 is a single rectangular exhaust behind each nacelle, replacing two circular openings that were standard on the Convair-Liners. Cabin-noise reduction program (AW Mar. 21, p. 10, Mar. 28, p. 87) includes additional soundproofing in cabin. Other modifications will increase speed and allowable gross weight.

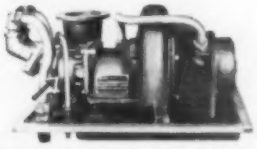
VICKERS® "Instant Response"* HYDRAULIC MOTOR ... THE AIRCRAFT HANDY MAN

*Called "Instant Response" because it starts, stops or reverses almost instantaneously.

Vickers Constant Displacement Piston Type Hydraulic Motors are available in 24 sizes for 3000 psi.

Here Are a Few of the Jobs It Is Doing:

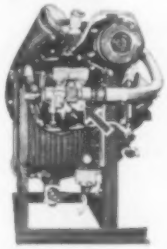
AERIAL REFUELING PUMP DRIVE



Fuel Transfer Pump built by Nash Engineering Co. for Boeing KC-97 Tanker. Powered by Vickers "Instant Response"* Hydraulic Motor.

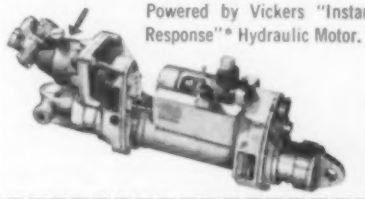
CABIN SUPERCHARGING

Douglas DC-7 Cabin Supercharger is driven by Vickers "Instant response"* Hydraulic Motor.

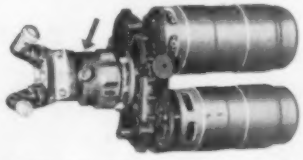


HORIZONTAL STABILIZER ACTUATOR

Built for Grumman F9F6 by Cleveland Pneumatic Tool Co. Powered by Vickers "Instant Response"* Hydraulic Motor.



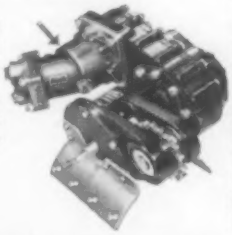
ALTERNATOR GENERATOR DRIVE



Alternator Generator Drive for Convair T-29 uses Vickers "Instant Response"* Hydraulic Motor.

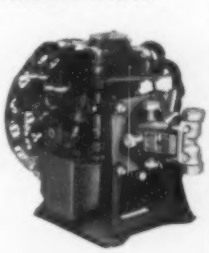
TELESCOPING BOOM ACTUATOR

Built by Jack & Heintz to extend and retract boom for in-flight refueling. Driven by a Vickers "Instant Response"* Hydraulic Motor.



AIR COMPRESSOR DRIVE

Built by Walter Kidde & Company, Inc. and driven by Vickers "Instant Response"* Hydraulic Motor.



What Can It Do for You?

These light-weight, compact, highly efficient hydraulic motors provide high power in a very small package. Their overall efficiency exceeds 92% . . . their volumetric efficiency exceeds 96%.

Operating characteristics are remarkable. These motors will stop from maximum speed in from .116 to .167 of a revolution . . . will accelerate from standstill to maximum speed in from .00019 to .0051 sec (depending on size). They can be stalled indefinitely without damage.

Vickers Hydraulic Motors have many uses on aircraft . . . just a few of them are shown above. Wherever you need high torque, high efficiency and high horsepower-weight ratio . . . or where instantaneous and positive control are required, these motors are your best choice. Write for Bulletin A-5205.

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PAC SPECIFICATIONS

ENGINE OVERHAUL . . . Unsurpassed in the industry . . . throughout its many years of service to private owners, corporate owners and the airlines, PAC engine overhauls have an unequalled record for dependability.

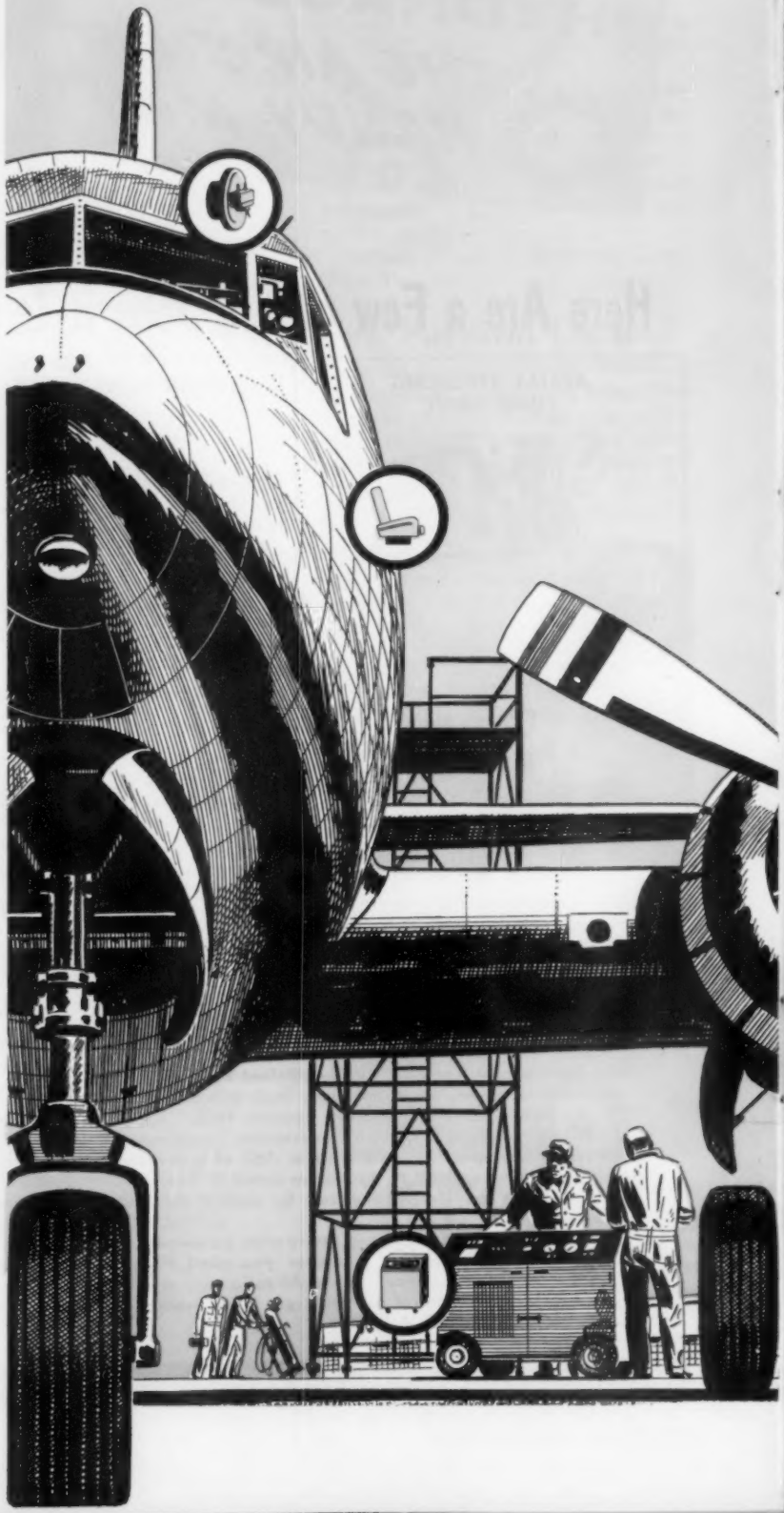
PAC "One Stop Service" . . . Complete overhaul and modification of aircraft and components. Engine maintenance and overhaul . . . Radio . . . Instruments . . . Instrument panels . . . Hydraulic and electrical systems . . . Tank seal . . . Painting . . . Storage and gas service.

COMPLETE inventory of aircraft parts and accessories through PAC. Bendix wheels and brakes . . . Goodrich Tires and tubes . . . Pratt & Whitney Aircraft parts . . . Scintilla magnetos . . . Eclipse Pioneer instruments and accessories . . . Hamilton Standard propellers . . . Bendix-Red Bank, Utica and Pacific Division products . . . many others.

TEST AND GROUND HANDLING equipment manufactured by PAC. Portable hydraulic test stands . . . Hydraulic test benches . . . Magneto test stands . . . Propeller test stands . . . PAC is fully staffed and equipped to design and manufacture specialized high capacity equipment to customer requirements both at Burbank, Calif. and at Linden, N. J.

CUSTOM INTERIORS at PAC . . . as done for such outstanding companies as: Imperial Oil Co., Convair 240 . . . Union Oil Co., Douglas DC-3, Convair 340 . . . B. F. Goodrich, Lockheed Lodestar . . . Massey-Harris-Ferguson, Lockheed Lodestar . . . Richfield Oil Corp., Douglas DC-3 . . . U. S. Steel Corp., Twin Beechcrafts, Lockheed Lodestars, Lockheed PV-1.

LIGHT WEIGHT cabin pressurization and low pressure pneumatic equipment manufactured by PAC. Cabin pressure regulators . . . Safety valves . . . Shut-off and modulating valves . . . Flow controllers . . . Pneumatic power pressure regulators.



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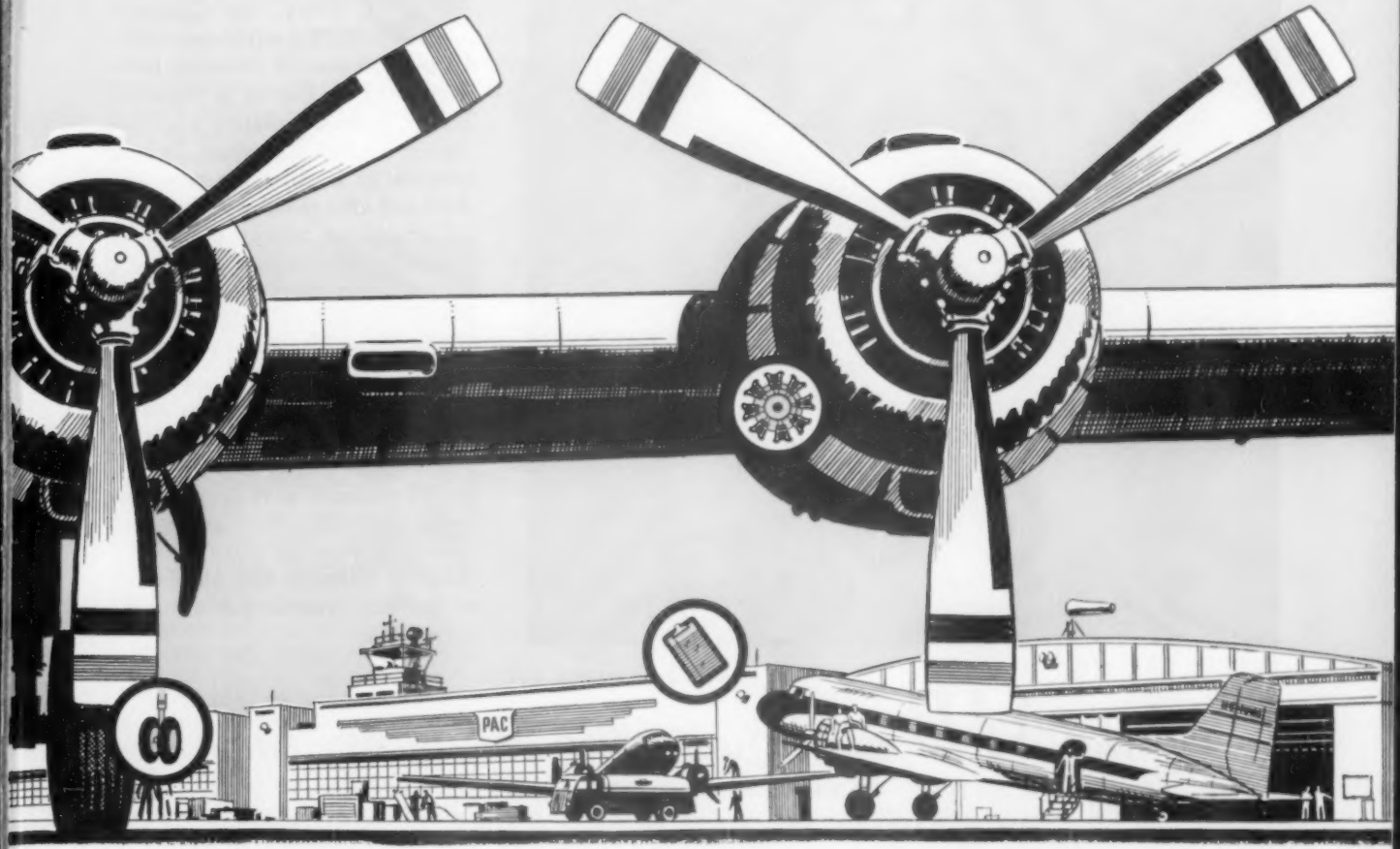
Business aircraft, airline fleet or private owner... PAC services and manufactured products can save you dollars in the form of operating efficiency, man hours, inventory and equipment utilization. See your nearby PAC representative first... for engine, airframe or accessory maintenance and overhaul... for PAC manufactured test, ground handling and cabin pressurization equipment. PAC is distributor in key areas for many of the world's leading manufacturers of aircraft parts and accessories. Write, wire or phone today for information on any PAC facility.



MB designed the engine mounts for the CONVAIR XFY-1

Straight up or straight-away, the Convair XFY-1 enjoys an equally high degree of freedom from vibration. Its engine is mounted on two types of isolating units designed by MB specialists. In any attitude of flight, these new MB 4941 and 4943 mounts do their job of absorbing power plant and propeller vibrations to protect the aircraft structure, instruments, and help reduce flight fatigue.

This is one more case where, right in the design stage, a major airplane manufacturer has relied on MB vibration engineering to answer special problems.

15 years of performance records with MB Mounts provide plenty of working proof that the aviation industry has placed the vibration control job in good hands.

the MB manufacturing company, inc.

1060 State Street, New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO *ISOLATE* VIBRATION...TO *EXCITE* IT...TO *MEASURE* IT

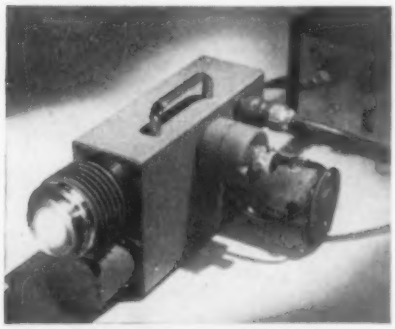
NEW AVIATION PRODUCTS

Blower Checks Fire Control Unit

Portable blower that provides a 185-mph. airstream has been devised by Northrop Aircraft, Inc., engineers for quick and accurate alignment and calibration of the attack sensor portion of the F-89D Scorpion's rocket fire control system.

The portable "windtunnel" pictured above uses a 28-v. d.c. electric fan. Airflow is directed over the airplane's angle of attack deflector probe. The units are being shipped to all USAF bases where F-89Ds are stationed.

Northrop Aircraft, Inc., Hawthorne, Calif.



Recorder Films Pressure Changes

Short-term pressure variations are film-recorded over a wide range by a device utilizing interferometric optical principles.

Model 216 pressure-transient recorder will measure from free-air manifestations or direct from a pressure vessel or by a hydraulic line from the pressure source. The device comprises two units: a combined transducer, optical system and camera with a 2-millisecond timing-pip system; and a control unit that can be located remotely.

The instrument essentially measures displacement of the transducer diaphragm and can be adapted to measuring any physical phenomena that can be translated into linear motion.

Beckman & Whitley, Inc., 906 E. San Carlos Ave., San Carlos, Calif.

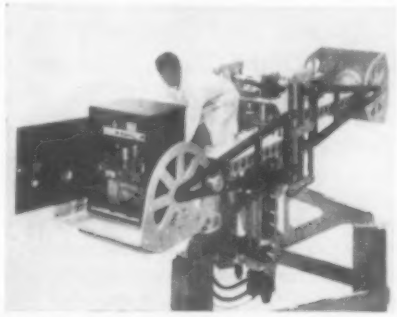
Unit Shows, Corrects Unbalance

Dynamic unbalance of highspeed rotors can be measured to better than 0.00001 in.-oz., by unskilled personnel, the maker of a new machine reports.

Rotor is mounted in a jig in front of the machine. It is brought to the desired speed, automatically controlled within 2 rpm. An electric spark marks the point of unbalance. Plane of unbalance and amount of corrective drilling is indicated visually.

Also mounted with the machine is a highspeed precision drill, to drill corrective holes.

Decker Aviation Corp., 1361 Frankford Ave., Philadelphia 25, Pa.



USAF Gets Equipment Centrifuge

A large rotary centrifuge capable of testing two pieces of equipment weighing 300 lb. and the size of 30-in. cubes has been built for the USAF Test Center at Edwards AFB, Calif.

Upper range of Model E-185 is 60G, with a capacity of 18,000 G-lb. at each of the two platforms. Automatic dynamic balancing shifts the composite centers of gravity of opposing centrifugal forces into the same rotating plane, the manufacturer says.

Power requirement is 7½ hp. from 0 to 30G acceleration takes about 15 sec.; 0-60 takes about 45 sec.

Genisco, Inc., 2233 Federal Ave., Los Angeles 64, Calif.

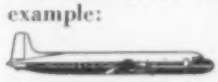
Test Stand Has High Flow Rate

A hydraulic test stand that can deliver fluid at pressures up to 5,000 psi. and flows of 40 gpm. has been developed by Greer Hydraulics, Inc. This is

Engineers!

Join this winning team!

At DOUGLAS you'll be associated with top engineers who have designed the key airplanes and missiles on the American scene today. For example:



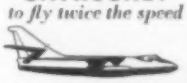
DC-7 "SEVEN SEAS" *America's finest, fastest airliner*

F4D "SKYRAY" *Only carrier plane to hold world's speed record*

C-124 "GLOBEMASTER" *World's largest production transport*

NIKE *Supersonic missile selected to protect our cities*

"SKYROCKET" *First airplane to fly twice the speed of sound*



A3D "SKYWARRIOR" *Largest carrier-based bomber*

A4D "SKYHAWK" *Smallest, lightest atom bomb carrier*

B-66 *Speedy, versatile jet bomber*

With its airplanes bracketing the field from the largest personnel and cargo transports to the smallest combat types, and a broad variety of missiles, Douglas offers the engineer and scientist unequalled job security, and the greatest opportunity for advancement.

For further information relative to employment opportunities at the Santa Monica, El Segundo and Long Beach, California, divisions and the Tulsa, Oklahoma, division, write today to:

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ROBINSON

Again Preferred for

VIBRATION CONTROL

NEW CAPITAL AIRLINES VISCOUNT powered by Rolls-Royce—Vibration control by ROBINSON

ANOTHER MAJOR AIRLINE SPECIFIES ROBINSON vibration control mounting systems. Capital Airlines, following the example of other leading airlines and manufacturers thus protects the valuable electronic equipment of its new Viscount.

A NEW CONCEPT IN FLIGHT. Viscount is one of the most advanced transport planes to be put into commercial service in the United States, providing practically noise-free flight at 30,000 feet. It is powered by four Rolls-Royce propeller turbine engines for a cruising speed of 335 miles per hour and a top speed of 385 m.p.h.

A NEW CONCEPT IN VIBRATION CONTROL. Robinson all-metal, specially engineered vibration and shock absorbing mounting systems protect Viscount's valuable electronic equipment against vibration. This, while imperceptible to passengers, may damage the delicate components of electronic equipment. Another benefit of effective vibration control is longer service life.

As aircraft engineers know, an electronic mounting system should have a high percentage of critical damping during resonance. The Met-L-Flex resilient wire cushions of Robinson Engineered Systems afford from 15 to 20% damping, at least 5 times that of outmoded rubber mounts. Their performance is unaffected by grease, oil, water, dust, extreme temperatures or environmental changes.

Allow us to advise you on the protection and installation of airborne electronic systems. We believe you will be interested in free Bulletin No. 800, entitled "Robinson Vibration and Shock Mounts for Guided Missiles, Rockets and Jet Aircraft". Address Airborne Division.

West Coast Engineering Office:
3006 Wilshire Blvd.,
Santa Monica, Calif.

ROBINSON AVIATION INC.
TETERBORO, NEW JERSEY
Vibration Control Engineers

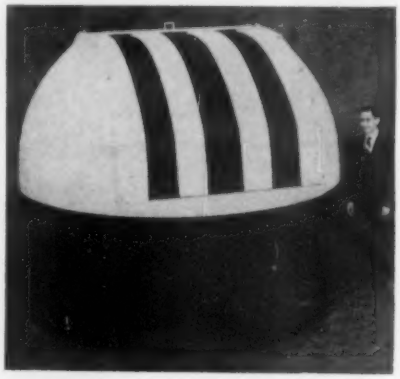
double the flow rate available in previous Greer models of this type.

Multiple circuit outlets permit the machine to test several components simultaneously.

The model KG-100 also has a 20,000-psi. hand pump for static and proof pressure testing, an air pressure circuit to test air system equipment, and an electrical circuit to check out d.c. system components. Precision instruments show flow rate and pressure.

Power is supplied by a 75-hp. electric motor.

Greer Hydraulics, Inc., New York International Airport, Jamaica 30, N. Y.



Dome Houses Tracking Gear

Servo-driven rotating dome for sheltering precision instruments used in tracking guided missiles will match action of the enclosed equipment even during highspeed close-range operation.

A novel oil seal between dome and base structure affords positive protection against weather and sand, the manufacturer states. Dome is constructed of fiber glass. Servo drive is tied to the tracking instrument, which rotates the dome on precision ball bearings on a 9½-ft.-dia. cylindrical base structure. Drive is effected by a pinion and 9½-ft. gear.

EE Division, Oerlikon Tool & Arms Corp. of America, Asheville, N. C.

New Telemetering Oscillator

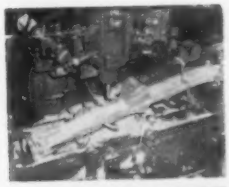
New inductance-controlled telemetering oscillators will provide accurate measurements of airspeed, pressure-altitude, air pressure perturbations on aircraft surfaces and other data on planes or missiles, according to the manufacturer.

The Series P-100 oscillators can be

LOUD *Mass Produces*

complex structural fittings

Modern day aircraft require lighter, stronger structure to cope with the higher loads encountered at speeds above Mach 1. The elimination of a single structural joint will often contribute a savings of many pounds in a highly loaded member. The result has been the trend to larger and more complex single structural fittings. Loud has made over 15,000 landing gear trunnion fittings which is an excellent example of mass producing a tough job while maintaining a high degree of quality.



CASE HISTORIES

Today's airplane is being built out of large forgings rather than fabricated sections. The spar fitting which combines landing gear trunnion support and wing spar into one single forged and machined fitting is representative of planes of tomorrow. Although this fitting is over 8 feet long it is machined on Loud's 120 inch Cincinnati hydrotels. Advance in designs create more complicated machined operations.

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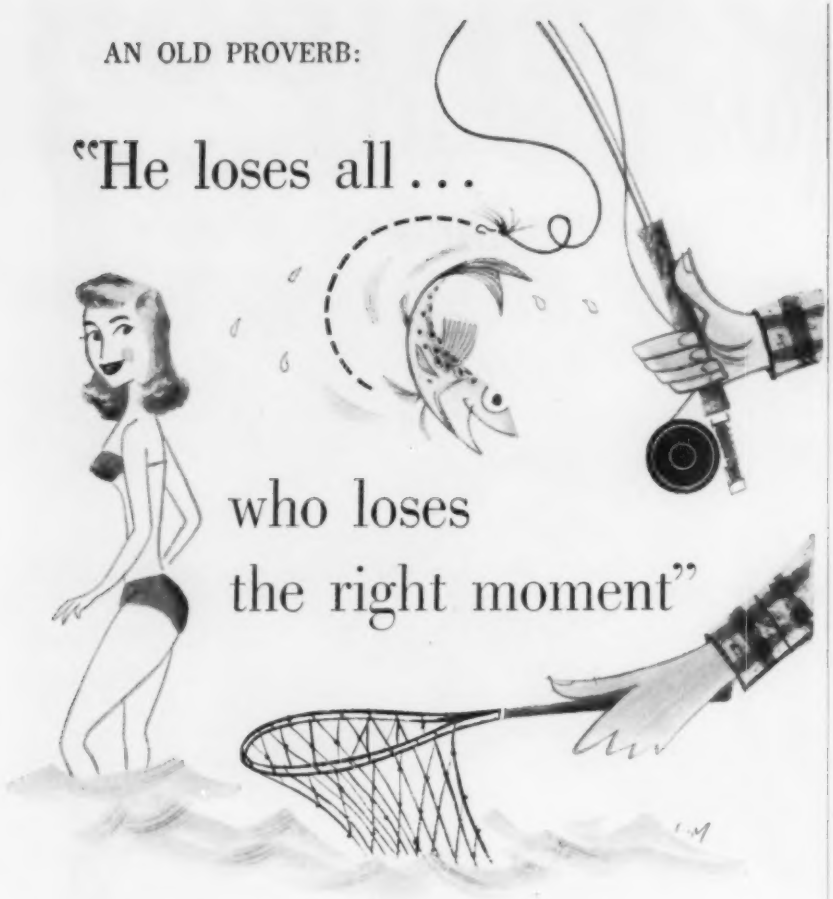

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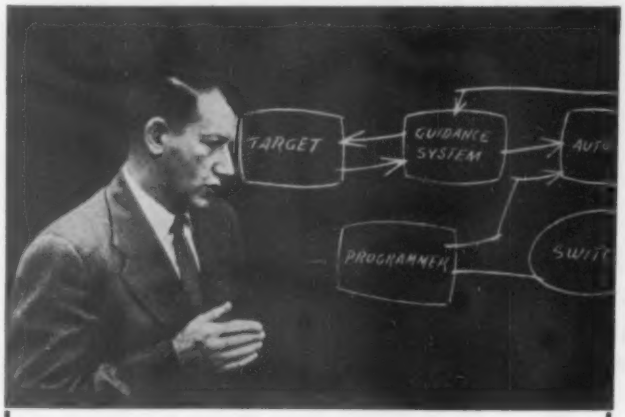

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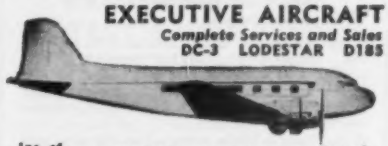

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Airlines Set All-Time 1st-Quarter Record

Booming business sends January-March profits above 1954's last three months, reversing usual slump.

By Preble Staver

Scheduled airlines experienced the best first quarter in the history of the air transport industry.

Profits in the first quarter of 1955 exceeded profits in the last quarter of 1954. This reverses the tradition that the first three months of the year are the poorest for the industry. All three classes of carriers—domestic trunklines, local service airlines and international carriers—usually suffer a "seasonal" drop in traffic.

All previous first-quarter records were broken—profits, revenues and traffic. This is traced directly to a continuance of high rate of business in the final quarter in 1954.

▶ **Net Income Gains**—The trunklines made more money in the last three months of 1954 than in any previous similar period, with a net operating income (before taxes) of $31 million. This year these carriers will report an operating net income somewhere between $35 and $40 million for January through March, as compared with a $2.8-million operating net income for the first quarter of 1954.

There is a strong likelihood the trend will continue throughout the entire year. If so, there is the possibility of the 13 trunklines alone showing an operating net income of more than $150 million. This is about double the 1954 net of $87.5 million.

The passenger load factor has always been a strong influence on profits. Both have been dropping since 1951. The industry figures that a 1% change in the load factor is equal to approximately $12 million in operating income. This measure held up for this year's first quarter as the load factors gained steadily. In some cases high load factors almost became embarrassing, particularly on weekends when carriers in certain markets couldn't meet the demand for seats.

Traffic gains of the first quarter are attributed to four major factors:

• **Weather.** The airlines benefited from the better than average weather conditions during the first quarter, particularly in the month of January. More flights were scheduled and completed because of good weather during the period.

• **Public Confidence.** General public confidence in business remained at a high level which was reflected in the travel market by the willingness to spend money.

• **Expanding economy.** A period of expansion in the national economy continues, following recovery from the slight recession of 1953 and early 1954. Air traffic is sensitive to the overall economy and, when times are good, they are very good for the airlines.

• **High level of spending.** The U. S. standard of living is still expanding and acts as spur to air travel. A strong construction market, such as the hotel-building boom in Miami and Hawaii, exerts a leverage on the air transportation business. The growth of resorts and more expensive vacations throughout the year are linked with air travel.

The airlines' first-class market made substantial gains during the first three months this year. Some carriers have been unable to meet the sudden demands for more first-class service after the heavy concentration on aircoach services.

Some segments of the industry believe that some of the novelty of coach is wearing off. The conclusion is that passengers are becoming more and more selective in their choice of service.

Trunklines

However, both classes of traffic increased. Total revenue passenger-miles for the trunklines for the first quarter showed a gain of 22.5% over the same three months in 1954; first-class miles increased 14.5%; and coach miles rose 38%. The Big Four—American, Eastern, TWA and United Air Lines—accounted for about 85% of the business. For January and February combined, American's revenue passenger-miles were up 19% over a year ago, while Eastern gained 22.99%; TWA increased 10.22% and United, 35.93%.

It is indicated from the percentage rates of increase that the carriers with the most and newest equipment are getting most of the business. The rate of growth on an annual basis was 13.9% in 1954, and January 1954 showed an increase of 13% over January 1953. The beginning of the business boom in the first quarter became apparent when January 1955 showed an increase of 26%, or twice the industry's previous average annual rate.

Passenger business represents 90% of the trunklines' revenues.

Local Service

Even more outstanding first-quarter results are being reported by the 14 local service air carriers. All signs point to an increasing acceptance of local service and in percentage gains the group exceeds the trunklines. The increase in total revenue passenger-miles for January and February combined was 40% for the locals over the same two months in 1954.

On an individual carrier basis the rate of growth or increase surpassed the most optimistic expectations. Revenue passenger-mile increases for January/February 1955 over the comparable period in 1954 were as follows: Allegheny, 26%; Bonanza, 30%; Central, 157%; Frontier, 42%; Lake Central, 20%; Mohawk, 39%; North Central, 38%; Ozark, 33%; Piedmont, 9%; Pioneer, 36%; Southern, 31%; South-

Total Revenue Passenger-Miles

Big Four	January-February 1955	January-February 1954	Percent Increase
American Airlines	590,171,000	493,081,000	19.69%
Eastern Air Lines	584,220,000	475,013,000	22.99%
United Air Lines	510,034,000	375,215,000	35.93%
Trans World Airlines	363,708,000	329,986,000	10.22%
Selected Trunklines			
Delta-C&S Air Lines	157,147,000	122,766,000	29.63%
National Airlines	177,001,000	135,854,000	30.29%
Western Air Lines	71,157,000	54,956,000	29.48%
Total 13 Trunklines	2,802,920,000	2,292,766,000	22.25%
First Class	1,856,251,000	1,608,264,000	14.5 %
Aircoach	946,669,000	684,502,000	38.30%

west, 45%; Trans-Texas, 44%; and West Coast, 34%.

International

U. S. international airlines also maintained the pace set by the domestic carriers in the first quarter. The flag carriers showed a 19% increase in total revenue passenger-miles flown. Two leading carriers were Northwest and Pan American with individual gains of 33% and 24%, respectively.

Forecasts for airline traffic and revenues for the first six months are termed excellent, with the second quarter expected to better the first. As to the second half of the year, however, industry leaders are divided in their opinions. One group predicts a sharp decline; another faction forecasts the best year in the industry's history.

All factions are agreed that the tremendous rush of business confronts the industry with two common problems:

• **Equipment.** All major companies have let substantial orders for new equipment but deliveries are scheduled for future years. Delivery of new equipment in 1955 will be considerably less than in recent years.

• **Manpower.** The problem of manpower becomes acute despite the continued increase of productivity per employe. It is closely related to equipment—newer and larger aircraft have required additional crews, ground station personnel and sales forces.

ANDB Sees U.S. Tacan Network by 1957

Installation of a Tacan airway system in the U. S., possibly within 18 months, is planned by the military services.

The system would consist of seven Tacan airways, three of them running from east to west and four from north to south. Requirements call for 170 ground stations and 22 mobile units.

Col. J. Francis Taylor, director of the Air Navigation Development Board, who revealed the proposal last week in Los Angeles, said military plans for the airways still are in the proposal stage. It still is too early to determine the date by which the network will be in operation, he said, adding that 18 months is a reasonable figure.

▶ **Channel Question**—The ANDB director would not comment on the number of channels which the controversial military short-range navigation system will require for the proposed seven-airway network.

He pointed out, however, that Tacan will be limited to 50 channels if the competing civil DME system remains on the air.

Number of channels required for a complete Tacan network still has not been determined, Taylor said. Some studies indicate 17 channels will be sufficient while others say 253 channels will be required.

Washington Hearings

Three events this week will highlight the Tacan–VOR/DME controversy. They are:

• Air Coordinating Committee is scheduled to receive its Navigation Panel's report with an ordered recommendation favoring Tacan or unanimous alternatives.

• House Appropriations subcommittee will hold closed-door hearings on the Civil Aeronautics Administration's budget for Fiscal 1956 which includes requests for 55 DME ground stations and funds for operation and maintenance of 447 stations.

• House Commerce subcommittee will review the record of testimony from all interested parties which was complicated by charges of "scandal" made last week by Max Karant, assistant general manager of the Aircraft Owners and Pilots Assn.

Charge of Scandal

Karant's suggestion that Tacan is "a scandal" climaxed an hour-long presentation to the committee in opposition to the Air Navigation and Development Board's recommendation favoring Tacan over civil DME as the eventual common system. The charge of scandal started a lengthy period of cross-examination. The committee agreed that any scandal or irregularities should be rooted out and demanded the facts.

▶ **Statement Questioned**—Chairman Oren Harris told Karant: "I can't help criticizing you for some of the exaggerated statements you've made. It hasn't been a very impressive performance. Some of your exaggerations are clean out of reason. For example, you've propagandized the country that a half billion dollar investment is being undermined by the military with Tacan and caused a lot of people around the country to get all excited."

"Can you substantiate what you've said?" Harris asked. He added: "A number of points need to be clarified. You've made some pretty strong statements—about the military and about certain manufacturers."

Karant touched off this line of questioning by stating: "As we looked around us in this Tacan controversy we found the company that developed the system in the first place—Federal Telecommunications and its parent company, International Telephone and Telegraph—heavy with admirals, generals, and valuable military contracts. We found this in most other radio and electronics firms we looked to for help. Some of the people we talked with knew full well that Tacan was a scandal. . . . This was even true with our own Vortac consultants. They were from Airborne Instrument Laboratories, Bell Laboratories, and Massachusetts Institute of Technology—all deeply concerned with military work."

▶ **Names Requested**—Rep. John Bell Williams told Karant he had heard rumors and gossip of scandal in the Tacan controversy. "I've also been told that if anyone could put the finger on this it would be you," he said.

Karant replied: "No, sir. I can't."

Rep. Carl Hinshaw asked for the names of people that had given Karant the impression that there was a scandal involved in Tacan. Karant said he wouldn't name any individuals, but agreed to submit names, dates and places in an executive session. Karant added: "Of course, I don't have all the details on all of the people involved."

Hinshaw asked if there was any Tacan contractor that should be investigated, Karant said he didn't think any specific contractor had done anything wrong.

UAL Orders 26 More Piston Transports

United Air Lines has increased its order with Douglas Aircraft Co. to 43 transports to supply equipment needs in the interim period before jet transports are available.

The latest order, announced at the annual stockholders' meeting, includes 15 DC-7s and 11 DC-6Bs at a cost of $42.5 million. This is in addition to previous orders for two DC-7s, 10 DC-6Bs and five DC-6As, bringing the total to $64.8 million.

"These additional aircraft will be for interim expansion to serve traffic growth until jet equipment comes into the picture," said UAL President W. A. Patterson. "It is our feeling that jet transports cannot be expected until about 1960."

The initial order of 17 aircraft is for 1956 delivery. The current 26-plane order will be delivered in 1957. The aircraft will be financed through operations funds and proceeds from existing bank credits.

Delays in CAB Rulings Warrant Court Action, Hoover Group Finds

By Katherine Johnsen

Civil Aeronautics Board's delay in reaching decisions warrants congressional investigation and should be subject to court action, according to a report to Congress on legal services and procedures by the Commission on Organization of the Executive Branch of Government, headed by former President Herbert Hoover.

The commission declared:

"Upon notice and after hearing, courts should be authorized upon proof of irreparable damage to issue mandatory injunctions to agencies to proceed to a decision upon a showing of undue delay; and upon judicial review, the agency should be permitted to show in defense that any delay was necessary, unavoidable, or in the public interest. . .

"Agency action unreasonably delayed was intended to be judicially reviewable. . . . Delays in the final decision of certain cases before the Federal Communications Commission and Civil Aeronautics Board are such as to require . . . investigation by the Congress and corrective action by the agencies concerned."

▶ **Decision Deadlines**—The commission proposed that agencies be required to render final decisions in non-hearing proceedings within three months from the date of filing, and within six months from the final hearing in proceedings involving hearings.

Other commission recommendations which would vitally affect CAB organization and procedure were:

• International airline cases should be subject to judicial review. The commission argues in favor of subjecting all executive actions to court review, stating that statutory exemptions, such as in the case of international air route decisions, "are based on the doctrine that, where Congress provides for grants and benefits, the agents of Congress have the power to determine the recipients of such grants and benefits, and Congress can preclude judicial review of the selection of the objects of its bounty."

But, the commission contended, "the Congress can be assured that its objectives are fully complied with only if claimants are given a day in court to test the exercise of administrative action in the light of the authority conferred.

"Judicial review of agency action in such cases does not mean the substitution of judicial judgment for administrative judgment. It means only that the citizens shall be entitled to assert before the court that the agency's decision was so obviously in error as to amount to an abuse or clearly unwarranted exercise of discretion."

• **A set of qualifications** as to "character and competence" should be established for lawyer and non-lawyer practitioners. CAB has never established any such qualifications.

"The public interest requires that safeguards exist with respect to admission to practice," the commission maintained.

• **Standards of conduct** for practitioners should also be established.

The commission said that these "should prohibit the representation of conflicting interests, the solicitation of clients, improper advertising, private communications with agencies on the merits of pending cases, and attempts to influence agency action or decision by threats, false accusations, duress, promises, gifts, or other forms of undue or improper pressure."

• **Former CAB employes** who "dealt with, passed upon, or gained material information concerning" Board matters should not be permitted to represent private clients involved in these matters after leaving government service.

The commission commented:

"Not infrequently persons employed by the executive branch have obtained information which they turned to advantage upon severance of employment.

"It is contrary to legal ethics for a lawyer to switch sides in a lawsuit without the consent of all parties. The same rule should apply to all representatives."

• **An office of legal services** and procedure should be established in the Department of Justice to handle the recruitment of attorneys for all government agencies and departments.

• **CAB's functions** in "trade" regulation should be transferred to a new "administrative court of the U.S." These would include enforcement actions, and actions relating to unlawful or unfair methods of competition, or unfair or deceptive trade practices.

• **Examiners should be replaced** by "commissioners" under the administrative control of the U. S. Administrative Court." A "Chief Hearing Commissioner," appointed by the President with the approval of the Senate, and located in the "Administrative Court" would handle appointment and supervision of the hearing "commissioners" for all government agencies.

CAB Studies Speed

Civil Aeronautics Board is making a study of how its procedures for hearing and deciding cases can be accelerated. CAB Chairman Ross Rizley ordered the study shortly after becoming chairman last month. He told Aviation Week there was no doubt that CAB procedures were too slow, but that easy reform was greatly hampered by the provisions of the Administrative Procedures Act.

CAB Lets Fairchild Serve on Two Boards

Temporary approval of interlocking relationships between Pan American World Airways and Sherman M. Fairchild has been granted by the Civil Aeronautics Board in an amendment of an earlier decision.

In February, the CAB disapproved the relationship. Fairchild is a director of both Pan American and Fairchild Engine and Airplane Corp. Since the Fairchild company plans to produce the Fokker F-27 and either Pan American or its associated carriers are possible customers, the Board felt Fairchild would have conflicting interests.

Fairchild and PAA asked the CAB to reconsider its action. They argued that PAA isn't a potential customer for the F-27, that PAA's affiliates make their own decisions on aircraft purchases and that manufacture of the F-27 depends on a series of conditions which may never occur.

The Board still believes that Fairchild will be in a position of conflicting interest when the Fairchild company starts selling the F-27, but it feels justified in approving the relationship for a limited time while a decision on manufacturing the F-27, is being made.

DC-3 Crash Blamed On Company, Pilot

Poor judgment and inadequate flight planning are blamed by the Civil Aeronautics Board for the crash of a Johnson Flying Service DC-3 near Pittsburgh last December. The accident caused the deaths of nine passengers and the pilot.

The flight was engaged in a commercial air movement of military personnel between Newark, N. J., and Tacoma, Wash. The accident occurred when the airplane ran out of fuel and the pilot ditched it in the Monongahela River. The plane was evacuated, but 10 people died trying to reach shore in the freezing waters.

The investigation found:

• The company didn't properly check

the competency of the crew in accordance with the operations manual prior to flight assignment.

• The aircraft was overloaded on takeoff.

• The flight was improperly planned, and was not conducted in accordance with the company's own operations manual.

• The pilot, contrary to the operations manual, passed a suitable refueling point after being advised that if the flight continued to destination it would be necessary to use reserve fuel.

▶ **Navigation Error**—"The general conduct of this flight," said the CAB, "clearly indicates poor judgment, carelessness, and lack of supervision and training. The fact that a flight plan and log were not prepared prior to departing Newark and that the co-pilot did not know the route to be flown was the result of poor crew coordination and flight planning."

The exact amount of fuel used is not known, but the report finds there wasn't enough fuel aboard to reach Pittsburgh with any safety margin.

At one point on the flight, the airplane reported over Johnstown, Pa., and asked that the Johnstown Airport runway lights to be turned on. Although the crew testified that it did not see them, it has been established that both runway lights and rotating beacon were on at the time and must have been visible if the aircraft was in the area. Apparently a navigational error was made and the airplane was somewhere else.

PAA Vibrometer Aids Passenger Comfort

Pan American World Airways is using a new instrument to help cut propeller vibration to a minimum and improve passenger comfort on trans-Pacific Stratocruisers.

Developed by the flight engineering section of PAA's Pacific-Alaska Division, the vibrometer measures vibration in the cockpit and gives crews a yardstick for phasing propellers to the lowest noise level.

The device is based on the principle that vibration is produced when the heaviest blades on each of the Stratocruiser's four props are straight up at the same instant in flight. If the relative position of each heavy blade is changed, noise and vibration are reduced.

After propellers are synchronized at the same cruise rpm., one engine on PAA's trans-Pacific transport is selected as the master and the next gains or loses on the first powerplant. Decrease or increase puts the heavy blades in every possible relative position until a point of least vibration is indicated on the vibrometer.

Airlines Report on Officials Pay

Officers and directors of scheduled airlines last week filed the following reports on salaries, bonuses and indirect compensation for 1954:

Aerovias Sud Americana, Inc. V. V. Carmichael, Jr., president and director, $10,200 salary, $250 bonus and indirect compensation; Paull E. Dixon, Jr., vice president and director, $10,200 salary and $250 bonus and indirect compensation; C. Booker Powell, vice president and director, $6,000 salary; R. C. Minor, vice president, $6,100 salary; Henry C. Palmer, secretary, $6,400 salary; J. D. Rains, treasurer, $10,000 salary.

Allegheny Airlines, Inc. Leslie O. Barnes, president and director, $16,666.72 salary; Everett K. Arnold, vice president and secretary, $10,000 salary; David L. Miller, vice president and director, $10,000 salary; Walter Short, treasurer, $10,000 salary; Jean C. Langsdale, assistant secretary, $3,600 salary. Hale Stimson, Russell, Nickerson, legal counsel, $18,000 salary.

Braniff Airways, Inc. C. E. Beard, president, $33,750 salary, $2,296 bonus and indirect compensation; J. W. Miller, executive vice president, $31,175 salary and $2,203 bonus; R. C. Schrader, vice president, $14,313 salary, and $938 bonus; C. G. Adams, vice president and secretary, $22,500 salary and $1,552 bonus; O. W. Crane, treasurer, $11,475 salary and $725 bonus; R. L. Barrier, assistant treasurer, $9,240 salary and $558 bonus; Loyd Eden, assistant treasurer, $9,240 salary and $558 bonus; Velta Bowlware, assistant secretary, $4,500 salary and $203 bonus; F. J. Beisecker, assistant treasurer, $9,240 salary and $558 bonus; W. A. Kropff, assistant vice president, $11,850 salary and $754 bonus; R. K. Brack, vice president, $14,475 salary and $408 bonus; J. M. Harrison, vice president, $12,075 salary and $771 bonus; W. M. Henshel, vice president, $14,250 salary and $934 bonus; R. V. Carlton, vice president, $21,500 salary and $1,478 bonus; George Butler, director, $700 bonus; W. V. Flennilsen, director, $200 bonus; T. N. Law, director, no salary and $900 bonus; Fred Jones, director, $1,400 bonus; E. C. Eppley, director, $1,000 bonus; R. Everstadt, director, $1,100 bonus; R. J. Whiteford, director, $900 bonus; T. F. Ryan, director, $1,100 bonus; G. D. Murdock, director, $1,300 bonus; G. W. Rice, director (resigned), $600 bonus. Whiteford, Hart, Carmody and Wilson, legal counsel, $60,000.

Hawaiian Airlines, Ltd. S. C. Kennedy, president and director, $24,525 salary and $300 bonus and indirect compensation; Ford Studebaker, executive vice president and director, $17,500 salary and $300 bonus; David Watson, vice president and director, $15,500 salary and $180 bonus; John S. Pugh, secretary, $10,500 salary; Brian Cooke, treasurer, $9,933 salary; G. K. Tanabe, assistant treasurer, $8,000 salary (elected Aug. 26); M. B. Carson, director, no salary and $320 bonus; James Greenwell, director, $740 bonus; Thomas Guard, director, $220 bonus; D. C. Lewis, director, $520 bonus; P. K. McLean, director, $240 bonus; J. E. Russell, director, $240 bonus; W. C. Tsukiyama, director, $300 bonus; George Vicars, director, $340 bonus; R. Von Temptsky, director, $240 bonus; H. W. B. White, director, $740 bonus; G. P. Wilcox, director, $120 bonus; George S. Wong, director, $260 bonus and H. V. Von Holt, director, $180 bonus (resigned Aug. 26). McKinsey and Co., organization study, $19,450. Henry Beeckon & Associates, consultants, $14,899. Robertson, Castle and Anthony, legal services, $13,800.

Northeast Airlines, Inc. George E. Gardner, president and director, $25,000 salary and $5,000 bonus and indirect compensation; A. A. Lane, vice president-operations, $15,000 salary and $1,500 bonus; R. L. Turner, vice president-traffic and sales, $15,000 salary and $3,000 bonus; D. W. H. MacKinnon, vice president-engineering and maintenance, $12,000 salary and $1,000 bonus; Hamilton Heard, treasurer, $15,000 salary and $1,500 bonus; G. E. Reed, assistant treasurer (elected Nov. 1954) $1,087.50 salary and $250 bonus. Foley, Hoag and Eliot, legal counsel, $34,000. Lybrand, Ross Bros. and Montgomery, auditors, $14,453.

National Airlines. G. T. Baker, president and director, $30,000 salary and $32,128 bonus and indirect compensation; R. E. Wieland, regional vice president, $12,000 salary and $13,066 bonus; A. G. Hardy, vice president, $12,000 salary and $10,994 bonus; J. L. Norris, vice president, $12,000 salary and $13,051 bonus; C. F. Sharp, vice president-customer relations, $12,000 salary and $13,051 bonus; J. M. Rosenthal, vice president-industrial relations, $12,000 salary and $13,051 bonus; C. H. Calhoun, vice president-mantenance, $10,000 salary, and $13,051 bonus; C. E. Banks, vice president-production (elected July 1954) $6,000 salary and $1,760 bonus; J. C. Brawner, treasurer and director, $12,000 salary and $13,051 bonus; R. P. Foreman, secretary and director, $12,000 salary and $13,051 bonus; W. F. Johnston, assistant treasurer and assistant secretary, $11,000 salary and $11,964 bonus. Cummings, Stanley, Truitt and Cross, legal counsel, $50,833.30. Loftin, Anderson, Scott, McCarthy and Preston, legal counsel, $24,999.99. Kreiger and Jorgenson, legal services, $25,213.97.

Northwest Airlines, Inc. Harold R. Harris, president (resigned effective Mar. 4) $31,667 salary, no bonus or indirect compensation; D. W. Nyrop, president (elected Sept. 27) $13,578 salary; Malcolm S. Mackay, executive vice president, $29,263 salary; Frank C. Judd, vice president-operations and engineering, $25,000 salary; James W. Mariner, vice president-sales, $18,000 salary; Willis Player, vice president-public relations (resigned effective Mar. 4) $10,500 salary; L. C. Glotzback, vice president-personnel, $22,000 salary; L. B. Kinports, vice president-Orient Region, $17,039 salary; A. E. Floan, vice president and secretary, $21,000 salary; L. S. Holstad, comptroller, $19,705 salary; William J. Eiden, treasurer, $19,394 salary; A. D. Piepgras, assistant comptroller, $12,000 salary; D. H. Hardesty, assistant treasurer (elected Mar. 4), $9,980 salary; F. J. Scott, assistant secretary, $9,600 salary; Dale Merrick, assistant vice president-properties, $13,000 salary; C. L. Stewart, assistant vice president-plans, $11,000 salary.

Croll Hunter, chairman of the board of directors, $50,000 salary, no bonus or indirect compensation; J. H. Binger, director, $500 salary; Morton H. Fry, director, $4,733 salary; R. M. Hardy, director, $700 salary; Joseph Johnson, director, $6,100 salary; Alonzo Petteys, director, $1,400 salary; C. Frank Reavis, director, $1,859 salary; A. G. Redpath, director, $1,200 salary; William Stern, director, $10,000 salary; A. F. Tegen, director, $4,233 salary; L. E. Wakefield, director, $1,100 salary; A. J. Weatherhead, director, $900 salary; Wheelock Whitney, director, $1,200 salary.

Ernst and Ernst, consultants, $29,288. C. Edward Leasure, legal counsel, $44,500.

Copter Expansion

Sabena Belgian World Airlines is inaugurating scheduled helicopter service to Eindhoven, Holland, and Duisborg and Dortmund in Germany. The new flights will increase the carrier's passenger copter network in Europe to an 11-city pattern.

Service to the three cities starts this week, made possible by Sabena's recent acquisition of two more seven-passenger Sikorsky S-55s. Three flights will be operated daily from the airline's base at Brussels to Eindhoven and Duisborg. One will extend to Dortmund.

Hodges, Reavis, McGrath, Pantaleoni and Downey, legal and financial consultants, $75,083. Carson and Lundin, architects, $16,466. Cleary, Gottlieb, Friendly and Hamilton, legal counsel, $13,733. Daniel M. Peterson, promotional and publicity, $18,721. William Quasha and Associates, legal counsel, $13,900.

CAB ORDERS

(Mar. 31-Apr. 6)

GRANTED:

Leave to intervene in the case involving Piedmont Aviation's application for extension to Washington to American Airlines, Capital Airlines, Eastern Air Lines, city of Charlottesville and county of Albemarle, Va., and the Charlottesville and Albemarle Chamber of Commerce.

Flying Tiger Line an extension of a temporary exemption granted to permit transportation until Apr. 30 of migratory agrarian workers among the United States and British West Indies, British Guiana and British Honduras.

Leave to intervene in the helicopter air service renewal case to city of Chicago Heights, Ill.; city of Elgin, Ill.; the Elgin Association of Commerce; city of Evanston, Ill.; city of Geneva, Ill.; Geneva Chamber of Commerce; city of Joliet, Ill.; Joliet Association of Commerce, and the Illinois Department of Aeronautics.

Colonial Airlines an extension of its exemption to serve Philadelphia-Camden on flights between Syracuse, N. Y., and Washington, D. C., for one year.

Frontier Airlines an exemption to serve Vernal, Utah, on a daily roundtrip flight between Salt Lake City and Grand Junction, Colo., and authorization to omit service at Vernal on a daily roundtrip flight between Salt Lake City and Billings, Mont.

Leave to intervene in the airfreight renewal case to city of Dallas, Tex.; Dallas Chamber of Commerce; city of Oklahoma City, Okla., and the Oklahoma City Chamber of Commerce.

APPROVED:

Agreements between various carriers adopted by International Air Transport Assn. and relating to certain Class-B fares on routes of National Greek Airline in the Middle East.

Intercompany agreements between Delta-C&S Air Lines, Trans World Airlines and various other carriers.

AUTHORIZED:

Resort Airlines to suspend service to Havana and Nassau between Apr. 1 and June 3; to Veradero, Cuba, and Kingston, Jamaica, between Apr. 3, 1955, and Jan. 1, 1956, and to Ciudad Trujillo, St. Thomas, San Juan and Washington, D. C., between Apr. 1, 1955, and Jan. 1, 1956.

ORDERED:

Ozark Air Lines' temporary certificate amendment to include Galesburg, Ill., be stayed until May 23.

Order directing Ozark Air Lines to show cause on service to Rockford, Ill., and Clinton, Iowa, vacated since service is now being rendered.

Pioneer Air Lines certificate for Route 64 transferred to Continental Air Lines effective Apr. 1.

DENIED:

Lake Central Airlines permission to serve Springfield, Ohio, through the Dayton Municipal Airport.

Northwest Orient Airlines' application to eliminate or suspend service at Jamestown, N. D.

DISMISSED:

Investigations of certain rates filed by Johnson Flying Service, Standard Airways and General Airways, since the rates have been canceled.

U.S. Helps Pakistan Civil Airways System

Development of a modern civil airways system for Pakistan is under way with the grant of about $1 million by the Foreign Operations Administration and a Pakistan grant of funds of $267,000.

FOA, working with Civil Aeronautics Administration, will:

- Train all types of maintenance personnel.
- Install modern radio-telegraph facilities.
- Establish new upper air sounding stations in the cities Karachi, Dacca and Lahore.
- Convert Nawabshah Airport in Sind Province into an alternate international airport by improving the runway system.

Pakistani personnel will study procedures in handling modern airways equipment for eight to ten months. This training program will take place at CAA's training center at Oklahoma City, Okla.

A CAA engineer is in Pakistan to start the program. He will return to the U.S. to assist in the procurement of equipment. Three CAA airways experts will be assigned to the program later.

"The new airways installation and navigational aids," FOA said, "will be a direct contribution to the safety of operations of international routes by U.S. flag carriers."

TCA to Start Freight Flights Coast-to-Coast

Trans-Canada Air Lines will inaugurate daily transcontinental airfreight flights May 1 between Vancouver and Montreal. The coast-to-coast all-cargo service will be Canada's first.

Two North Stars now are being stripped of seats, galleys and other passenger facilities and converted to freighter configuration. Each transport will be able to lift an estimated six tons of freight.

Schedule calls for five flights a week. They will be nonstop from Vancouver to Winnipeg and terminate in Montreal.

SHORTLINES

► **Air-India International** extends its London-Hong Kong route to Toyko Apr. 22. Service will be operated once a week in each direction between London and Tokyo.

► **AER Lingus** plans to add Biarritz and Barcelona to its system in May by extending its Dublin-Lourdes route to those points.

► **British Overseas Airways Corp.** is operating ten weekly tourist flights in each direction between New York and Bermuda.

► **Bonanza Air Lines** reports a March load factor of 63.4% and a load factor of 61% for the first quarter of this year. Traffic of 5,315,000 revenue passenger-miles in the first quarter represents an increase of 34% over the same period of 1954.

► **Central Airlines** had its best traffic month in March when 7,989 passengers were boarded, and 87% increase over March 1954. During the same period, revenue passenger-miles increased 163% from 499,000 to 1,310,539.

► **National Airlines** reports March traffic showed a 20% increase over March 1954.

► **Trans-Canada Airlines** is reported planning to extend its Viscount service from Montreal to Calgary via Ottawa, Fort William and Winnipeg early in July.

► **Sabena Belgian World Airlines** is extending its helicopter network to Duisborg and Dortmund, Germany, and Eindhoven, Holland, bringing the total of continental cities served to eleven.

► **United Air Lines** reports record traffic in March. The carrier flew 292,236,000 revenue passenger-miles, a 42% increase over 1954. Freight reached 3,398,000 ton-miles, express 998,000 ton-miles and mail 2,378,000 ton-miles . . . UAL has cut freight rates 4 to 8% on general commodities between Honolulu and 79 mainland cities.

► **Riddle Airlines** had earnings of $78,993 for the eight months ending Mar. 1, including a net profit of $8,055 in February.

► **Swissair** will start weekly service between Zurich and Damascus via Istanbul and Beirut Apr. 17.

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It's Coming...

EDITORIAL

False Economy

A critical blow has been struck at the foundations of American airpower by the House Appropriations Subcommittee on Independent Offices headed by Albert Thomas of Texas. This subcommittee has recommended to the House an $8.8 million cut in the Fiscal 1956 budget of the National Advisory Committee for Aeronautics. On the surface this appears to be an insignificant amount particularly when compared with the $20 billion requested for procurement and operation of military aircraft and guided missiles.

Yet this $8.8 million cut in the NACA budget can have a disastrous effect on the quality and military effectiveness of the $20 billion worth of airpower Congress is willing to buy without question. The basic research and development activities of NACA are the foundation on which virtually all of the aircraft and missile development in the western world rests. NACA does little work on nuclear weapons development but its research and development is involved with every type of delivery system now under consideration to put these weapons on enemy targets.

It is no secret that development of atomic and hydrogen weapons has far outstripped the development of efficient delivery systems. Obviously our present superiority in nuclear weapons will be of little avail without a corresponding superiority in delivery methods. Every responsible top-level official concerned with development of military airpower in this country has warned that we are in the midst of a fierce technological race with Russia for supremacy in nuclear weapons and delivery systems.

In this race, NACA occupies a key position of support for the technological, military and industrial effort that translates its data into combat-ready military airpower. During preparation of the Fiscal 1956 budget Drs. Jerome C. Hunsaker and Hugh L. Dryden, chairman and director respectively of NACA, made a personal presentation to President Eisenhower at the White House, on the critical need for accelerated research effort to meet the pace of this international technological competition.

Despite his deep desire to cut federal expenditures and balance the budget, President Eisenhower authorized a 10% increase in the NACA research budget. The President's decision was based on his recognition of the critical position of our aeronautical research effort.

This 10% increase in the NACA research effort has been wiped out by the House committee. It means that accelerated effort in the critical fields of stability and control, aircraft and missile structures, supersonic and transonic drag, rocket fuels and nuclear propulsion will have to be abandoned. All of this costs $5.8 million.

This year the aircraft and missile industry will be making their first use of the Unitary plan supersonic windtunnels built on NACA facilities and scheduled to be operated by NACA personnel. Congress and the Defense Department placed high priority on the Unitary plan's facilities as a vital tool for accelerating aircraft and missile development.

The $1.6 million slash from the Unitary tunnel operations budget will mean less running time for critical military projects, longer time required for data reduction and a general slow-down on this high priority project. Another $1.3 million has been cut from proposed construction of new research facilities. This 10% slash in the $13 million budget request will have an effect far beyond that envisioned by the committee that recommended the cut. It is impossible to cut 10% from a windtunnel. If sufficient money is not available for the entire project, it must be dropped from the schedule.

Perhaps one of the basic faults underlying the action of the House committee is that NACA has been extremely reluctant to publicize its accomplishments or share credit when they are translated into events of national importance. For example, few people outside the aircraft industry today know the story of the NACA-developed laminar flow wing that made it possible for the North American P-51 Mustang to escort bombers all the way to Berlin during World War II. Many people even in the aircraft industry today are not aware of another NACA discovery that has had a profound affect on improved performance of all new USAF and Navy supersonic fighters. Without the millions spent on NACA's fundamental research and development work, the billions later spent on aircraft and missile procurement could easily be wasted on inferior equipment.

We earnestly urge congressmen and senators who will pass final judgment on the scale of NACA's research effort for the future to consider the few millions required to do this job adequately. Voting the billions for procurement without the vital millions for research and development is false economy of a disastrous brand.

The Langley Gold Medal

The Langley Gold Medal awarded by the Smithsonian Institution is one of Aviation's rarest and highest honors. Since Wilbur and Orville Wright received the first Langley medal in 1909 it has been awarded on only five other occasions.

The presentation to Dr. Hunsaker was made at a private reception and dinner in the Great Hall of the Smithsonian by the Hon. Earl Warren, Chief Justice of the United States, acting in his capacity as Chancellor of the Smithsonian's board of regents.

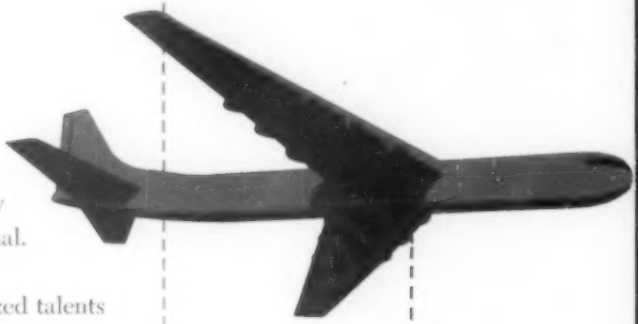
The citation accompanying the medal as read by Justice Warren said the award to Dr. Hunsaker was: "In recognition of your unique and superlative important contributions to aeronautics as a distinguished designer of aircraft, as the creator of a great center for instruction in aeronautical engineering, and as the scientific genius under whose leadership the present-day National Advisory Committee for Aeronautics has become the world's greatest scientific aeronautic research organization."

It is a fitting reward for a lifetime of contributions to aeronautical development that almost spans the history of powered flight. —Robert Hotz

one phase of **LEACH** *leadership*

Building, not avoiding, the difficult relays

Some firms shun unusual products, deal only with *standard* units . . . the ones with no design challenge. At Leach Relay Division, on the other hand, we are interested in the unusual. And we're particularly well equipped to handle your complex relay problems, because we can call on the specialized talents of our four companies . . . all operating under the Leach Corporation's *centralized responsibility.* Here, for example, are three long-standing aircraft problems and the Leach Relays . . . each a complete, hermetically sealed control package . . . that solved them . . .



ON THE GROUND . . . incorrectly phased ground power can cause serious damage.

LEACH'S ANSWER . . . 9243 Phase-Sequence Relay, which includes a 3-phase stall torque motor and control switches. Unless the predetermined phase sequence is applied at normal voltage, the relay will not allow the main contactor to close.

IN THE AIR . . . relays must operate from low-level indicators (e.g., thermocouples, subminiature tubes, small slip rings) and shock resistance is vital.

LEACH'S ANSWER . . . 9262, a combination of relay and magnetic amplifier, is sensitive to 1 *milliwatt*, is immune to shocks as great as 50 g. In addition it is compact and light.

ON COURSE . . . gyro compasses drift if voltage input drops, but the back EMF they generate holds normal relays closed for 15-30 minutes.

LEACH'S ANSWER . . . 9247 Close-Differential Relay, a combination of magnetic amplifier, rectifier, and relay which warns the pilot of any drop as small as 5 volts.

LEACH CORPORATION / LEACH RELAY DIVISION

5915 AVALON BOULEVARD, LOS ANGELES 3, CALIFORNIA

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SERVING INDUSTRY IN THE LABORATORY . . . IN THE PLANT . . . ON THE GROUND . . . IN THE AIR

DISTRICT OFFICES AND REPRESENTATIVES IN PRINCIPAL CITIES OF U.S. AND CANADA

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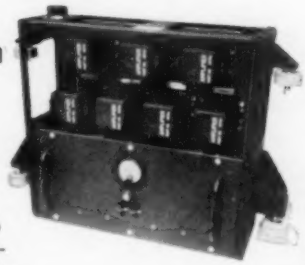
Every B-47 "STRATOJET"

Uses this Amplifier and Power Supply Rack . . . another Servomechanisms' "building block" system



This sub-system is another outstanding example of Servomechanisms' packaged function philosophy.

Consider the seven SA104H Servo Amplifiers used in this system. Servomechanisms has designed and produced over 40,000 of these amplifiers. All are 100% electrically and mechanically interchangeable. They are a USAF standard — designated Type A-1 — and as such are "shelf items" in supply depots throughout the world.

As a USAF standard, these amplifiers are used in many other systems in almost every modern fighter aircraft.

This demonstrates how Servomechanisms' packaged electronic functions have helped standardize and simplify fire control equipment—and why designers and users of control equipment specify Servomechanisms, Inc., for economy and reliability.

The reliability of Servomechanisms' equipment is directly traceable to the ease of maintenance inherent in the "building block" philosophy.

SERVOmechaNISMS INC.
PACKAGED FUNCTIONAL COMPONENTS

EASTERN DIVISION . . . Post and Stewart Aves., Westbury, N. Y. WESTERN DIVISION . . . 125000 Aviation Blvd., Hawthorne, Calif.